The Engineer.

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VOL. CXLIII.—No. 3716] LONDON: FRIDAY EVENING, APRIL 1, 1927 [PRICE { WITH SUPPLEMENT } ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

The Director-General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for :—
1. 1712 TONS STEEL RAILS and 3704 PAIRS of FISH PLATES.
2. 66 K.V.A. MOTOR-DRIVEN ALTERNATOR SETS, TRANSFORMERS, SWITCHGEAR, &c.

Tenders due on the 12th April, 1927, for No. 1, and on the 26th April, 1927, for No. 2.

Specifications and forms of Tender obtainable from the above at a fee of 5s. per set, which will not be returned. 5144

Assistant Engineers (2) REQUIRED by the RAILWAY DEPARTMENT of the FEDERATED MALAY STATES GOVERNMENT for four years' service, with possible extension. Salary 400 dollars, rising to 475 dollars a month by annual increments of 25 dollars a month, and thereafter, in the event of the officer being retained, rising to 800 dollars a month, plus a temporary non-pensionable allowance of 10 per cent. for bachelors and 20 per cent. for married men. The exchange value of the dollar in sterling is at present fixed by the Government at 2s. 4d., but the purchasing power of the dollar in Malaya is considerably less than that of 2s. 4d. in the United Kingdom. No income tax is at present imposed by the Federated Malay States Government. Free passages provided. Candidates, age 23 to 30, preferably unmarried, must have received a good theoretical training, preferably at a University or a College recognised by the Institution of Civil Engineers, and possess a Civil Engineering Degree, or obtained such other diploma or distinction in engineering as the Secretary of State may decide in any particular case, or completed their articles with a civil engineer of good standing and have passed the examination for Associate Membership of the Institution of Civil Engineers. Should have had at least one year's practical experience of railway maintenance on a British railway.—Apply at once by letter, giving brief details of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1 mentioning this paper and quoting clearly at head of application M/15162. 5153

The Government of BIHAR and ORISSA REQUIRE the SERVICES of an EXECUTIVE ENGINEER for the PUBLIC HEALTH DEPARTMENT (ENGINEERING BRANCH). Candidates must have had regular training as Civil Engineers and be either Associate Members of the Institution of Civil Engineers or hold equivalent professional qualifications. Seven years' good practical experience in England of the design and execution of waterworks and drainage is essential, and a general knowledge of mechanical and elementary electrical engineering is advantageous. Age 30 to 40 years.

Five years' agreement. Pay in accordance with an age scale, e.g., age 30, Rs. 725 a month plus overseas pay, £25 a month; age 40, Rs. 1175 a month plus overseas pay, £30 a month. Free first-class passage to India for self and wife and return passage on satisfactory termination of agreement. Provident Fund. Strict medical examination. (Overseas pay and return passage admissible only to an officer of non-Asiatic domicile.)

Further particulars and forms of application may be obtained (on request by post card) from the SECRETARY TO THE HIGH COMMISSIONER FOR INDIA, 42, Grosvenor-gardens, London, S.W. 1. Last date for receipt of applications 14th April, 1927. 5074

The Government of India REQUIRE the SERVICES of THREE ASSISTANT FOREMEN for the undermentioned Indian Ordnance Factories.

APPOINTMENT 86.
Gun and Shell Factory, Cossipore (Gun Mechanism Shop).

Must have served full term apprenticeship in an Engineering Works and have sound theoretical training. Should possess a knowledge of ordnance manufacture from 18 pounders to 6in., and a thorough knowledge and experience of gun mechanisms manufacture, particularly 3.7in. howitzers and 18-pounders to 6in. Some experience also in gauge making and, if possible, design. Age should be between 25 and 35 years.

APPOINTMENT 87.
Metal and Steel Factory, Ishapore (Case and Cupping Section).

Must be a qualified apprenticed mechanic with experience on Q.F. case and other metal pressing work, and be qualified to design and construct fittings and tools required for such work. Age should not be more than 35 years.

APPOINTMENT 88.
Gun and Shell Factory, Cossipore (Fuze Section, Manufacture of Empty Fuzes).

Must have served full term apprenticeship in an Engineering Works and have sound theoretical training. Should possess a knowledge of fuze work, mainly of the following fuzes :—No. 80 M.K. XI., No. 106; No. 101; and also of primers generally. Experience of any fuzes likely to replace the above types, an advantage. Some experience in gauge making and, if possible, design would be useful. A knowledge of the procedure for inspection of the product is necessary. Age should be between 25 and 35 years.

SALARY.—(For all three appointments) Rs. 450-15-510 per calendar month, with prospects of further increases.

TERMS.—Agreement for five years in the first instance. Free second-class passage to India and return passage on satisfactory termination of services. Free quarters. Medical examination.

Further particulars and forms of application may be obtained (on request by postcard quoting the number of the appointment) from the SECRETARY TO THE HIGH COMMISSIONER FOR INDIA, General Department, 42, Grosvenor-gardens, London, S.W. 1. Last date for receipt of applications 22nd April, 1927. 5115

In the High Court of Justice — Chancery Division — 1926. H. 065
Mr. Justice Tomlin
In the Matter of HEWITT & KELLETT LIMITED AND REDUCED
and
In the Matter of THE COMPANIES (CONSOLIDATION) ACT 1908

Notice is Hereby Given that a Petition presented to the High Court of Justice on the 22nd day of December 1926 for confirming the reduction of capital of the above Company from £36,000 to £10,880 is directed to be heard before Mr. Justice Tomlin on the 12th day of April 1927.

Dated the 30th day of March 1927.

JAMES B. SOMERVILLE,
of 11, New-square, Lincoln's Inn, W.C. 2.
Agent for F. G. and H. E. Smith, of 23, Kirkgate, Bradford, Yorkshire, Solicitors for the said Company. 5161

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.
ARRANGED FOR CARD INDEXING.

Kitson-Meyer Locomotive for Colombia (With a Two-Page Drawing). THE ENGINEER, 1-4-27.

Scientific and Industrial Research. THE ENGINEER, 1-4-27.

Lubrication. (W. R. ORMANDY.) THE ENGINEER, 1-4-27.

The Delaware Suspension Bridge—No. V. THE ENGINEER, 1-4-27.

The French Oil Problem. THE ENGINEER, 1-4-27.

The World's Future Supply of Liquid Fuel No. V. (J. B. C. KERSHAW.) THE ENGINEER, 1-4-27.

Railways and Unfair Competition. THE ENGINEER, 1-4-27.

Rotary Milling Machines. THE ENGINEER, 1-4-27.

The South African Steel Industry. THE ENGINEER, 1-4-27.

PUBLIC NOTICES

For Sale, About 36 Tons of C.I. PIPES and SPECIALS, principally 14in., lying at a depot near Torpoint, Cornwall.

Full particulars and forms of Tender may be obtained from the SUPERINTENDING CIVIL ENGINEER, H.M. Dockyard, Devonport. 5045

University of Liverpool.

FACULTY OF ENGINEERING.

DEAN: Professor C. O. BANNISTER, M. Eng., Assoc. R.S.M., F.I.C., M. Inst. M.M.

Prospectus and full particulars may be obtained on application to the REGISTRAR of courses designed for Students desiring to qualify as Mechanical, Electrical, Civil or Marine Engineers, as Naval Architects or as Metallurgists and Metallurgical Engineers. 5128

City of Sheffield.
PUBLIC ABATTOIR AND WHOLESALE MEAT MARKET.
TO BUILDING CONTRACTORS.

The Sheffield City Council is prepared to receive TENDERS from contractors for the ERECTION of a PUBLIC ABATTOIR and WHOLESALE MEAT MARKET in Cricket Inn-road, Sheffield.

Bills of quantities, forms of Tender, and conditions of contract may be obtained on and after April 11th, 1927, on application to the Town Clerk, Town Hall, Sheffield, and on deposit of Two Guineas, which will be returned on receipt of a bona fide Tender.

The drawings may be seen at the Town Clerk's Office, Sheffield, or at the office of the Architects and Engineers, Messrs. Hal Williams and Company, Factory House, 80, High Holborn, London, W.C. 1.

Tenders must be on the form provided, enclosed and sealed in official envelope, and delivered at the Town Clerk's office at the Town Hall not later than 4 p.m. on Thursday, the 21st day of April, 1927.

The Council does not bind itself to accept the lowest or any Tender.

Any person or firm tendering will be required to comply with the Council's form of clauses respecting wages, hours, and conditions of labour, and prohibition against assigning or sub-letting set out in the conditions of contract above referred to.

By Order,
WILLIAM E. HART,
Town Clerk.

Town Hall, Sheffield,
31st March, 1927. 5119

PUBLIC NOTICES

The Manchester Steam Users' Association.

The ANNUAL GENERAL MEETING of the MEMBERS was held in the Boardroom of the Association, at their Offices, 9, Mount-street, Manchester, on Tuesday, March 22nd, Harold Lee, Esq., J.P. (Manchester), President, in the chair, when the following resolutions were adopted :—

Moved by the Chairman, seconded by J. T. Browne, Esq., Pendlebury (Vice-President), and resolved :—

"That the Report of the Committee of Management to the Subscribers, together with the Financial Statement, for the year 1926, be and is hereby approved and adopted."

Moved by R. C. Macdonald, Esq. (South Metropolitan Gas Co., London), seconded by E. Turnbull, Esq. (Messrs. Tate and Lyle, Ltd., Liverpool), and resolved :—

"That the thanks of the Association are due and are hereby presented to the Committee of Management for their past services, and that the following gentlemen be elected the Committee for the ensuing year, with power to add to their number :—

COMMITTEE OF MANAGEMENT.
Harold Lee, Esq., J.P., Manchester.
A. Norman Dugdale, Esq., J.P., Blackburn.
Jas. Stanley Addison, Esq., London.
J. T. Browne, Esq., Pendlebury.
Alfred H. J. Cochrane, Esq., Openshaw.
Charles W. Crossley, Esq., J.P., Halifax.
George Lennard Bolden, Esq., Manchester."

Moved by G. H. Burrows, Esq. (Messrs. Filkington Bros., Ltd., St. Helens), seconded by —. Crawford, Esq. (Sladen Wood Mill Co., Littleborough), and resolved :—

"That Messrs. F. W. Popplewell and Son, Chartered Accountants, Manchester, be appointed Auditors of the Association's Accounts for the year 1927."

JAMES PARR,
Secretary.
9, Mount-street, Albert-square, Manchester,
23rd March, 1927. 5121

Engineer-in-Chief Wanted by one of the largest Electric Supply Companies in the kingdom, to Take Control of the Engineering Section of the Undertaking.

Applicants must have held positions of leading and superior responsibility and have had extensive experience of the problems involved in supply over wide areas, and in the design, construction and operation of modern Power Stations, Super-tension Transmission, and Distribution to the general body of consumers—bulk and otherwise.

The successful candidate will be required to devote his whole time to the duties of the office.

Applications, accompanied by copies of testimonials, to be sent to "ELECTRIC," c/o Street's, 6, Gracechurch-street, E.C.3 5148 A

PUBLIC NOTICES

The Institution of Structural Engineers.
BRENFORCE TRAVELLING SCHOLARSHIP, VALUE £300.

The "Brenforce Travelling Scholarship" will be awarded triennially, including 1927. The Scholarship is awarded "with the object of encouraging the æsthetic design and artistic development in England of buildings in concrete and reinforced concrete." The competition will consist of a problem in design, conducted on Beaux Arts methods (i.e., a preliminary twelve-hour sketch design, of which a copy is lodged, followed by finished final designs from the sketch, for which 28 days is allowed). Preliminary competition on Saturday, 7th May. Candidates must be members (in any class) of the Institution, between the ages of 21 and 40 years. Winner receives £300 and gold medal. Closing date for entries, Monday, 2nd May. Syllabus and full particulars from the undersigned.

MAURICE G. KIDDY, F.I.S.A.,
Secretary of the Institution.
10, Upper Belgrave-street, S.W. 1.
21st March, 1927. 5059

Belper Waterworks.
CONTRACT NO. 3.

The Belper Urban Council invite TENDERS for the ERECTION of a STONE-BUILT PUMP HOUSE at their Waterworks, together with the FOUNDATIONS for PUMPING MACHINERY.

The drawings may be seen and copies of the specification and schedule of works may be obtained from the Engineer, Mr. F. W. Hodson, M. Inst. C.E., at Bank Chambers, Loughborough, on deposit of cheque for £5 5s., which will be refunded on receipt of a bona fide Tender and the return of the documents.

Tenders are to be sent to the undersigned not later than 23rd April, 1927.

The Council do not bind themselves to accept the lowest or any Tender.

Dated this 22nd day of March, 1927.

J. PERCY R. FYM,
5067 Clerk to the Council.

Great Southern Railways.

The Directors of the Great Southern Railways, Ireland, are prepared to receive TENDERS for the SUPPLY of :—

TWO STEEL MOTOR BARGES,

suitable for use on the River Suir at Waterford.

The principal dimensions of the barges required are :—

Length, 61ft.;
Breadth, 13ft.;
Depth, 5ft.

Each barge is to be fitted with an Oil Engine and to be capable of towing another loaded barge of similar capacity (40 to 45 tons) against a river current of approximately two miles per hour.

Specifications and drawings can be obtained on application to the Company's Chief Mechanical Engineer, Inchicore, Dublin.

Tenders should be forwarded so as to reach the undersigned not later than Five o'clock p.m. on Wednesday, the 20th April.

The Directors do not bind themselves to accept the lowest or any Tender.

C. E. RILEY, Secretary.
Kingsbridge Station, Dublin,
March, 1927. 5116

The County of London Electric Supply Company, Ltd.
BARKING POWER STATION EXTENSIONS, 1926.
POWER STATION CABLING.

The County of London Electric Supply Company, Ltd., are open to receive TENDERS for the SUPPLY and INSTALLATION of CABLES and ACCESSORIES at their Barking Power Station. Copies of specification may be obtained by cable manufacturers from the offices of the Company on application to the undersigned, on or after March 28th, 1927, on payment of a fee of Five Guineas for the first copy and Two Guineas for every subsequent copy.

Sealed Tenders, marked "Tender for Cables and Accessories," should be addressed to the undersigned and lodged at the registered offices of the Company by Noon on May 9th, 1927. The sum paid for any number of specifications up to three will be refunded upon receipt of a bona fide Tender.

The Company do not bind themselves to accept the lowest or any Tender.

F. C. McQUOWN,
Joint Manager and Secretary.
The County of London Electric Supply Co., Ltd.,
Moorgate-court, Moorgate-place, London, E.C. 2.
5117

PUBLIC NOTICES (continued) Page 2.

SITUATIONS OPEN, Page 2.
SITUATIONS WANTED, Pages 2 and 4.
PARTNERSHIPS, Page 4.
COMPANY MEETINGS, Page 3.
EDUCATIONAL, Page 4.
AGENCIES, Page 8.
MISCELLANEOUS, Page 8.
AUCTIONS, Page 96.
MACHINERY, &c., WANTED, Page 4.
FOR HIRE, Page 8.
FOR SALE, Pages 8 and 96.
PATENTS, Page 8.
BUSINESSES and PREMISES (For Sale, etc.), Page 96.
WORK WANTED, Page 6.

For Advertisement Rates see Leader Page.

INDEX TO ADVERTISEMENTS Page 95.

PUBLIC NOTICES

South Indian Railway Company,
LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of :—

1. LOCOMOTIVE BOILERS (TWO).
2. SOLID-DRAWN STEEL BOILER TUBES.
3. HELICAL and VOLUTE SPRINGS.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tender for Locomotive Boilers," or as the case may be, must be left with the undersigned not later than Twelve Noon on Friday, the 22nd April, 1927.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 10s. for each copy of each specification.

Copies of the drawings may be obtained at the offices of the Company's Consulting Engineers, Messrs. Robert White and Partners, 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.

91, Petty France, Westminster, S.W. 1,
30th March, 1927. 5160

The Rural District Council
OF CHELMSFORD.
INGATESTONE WATERWORKS.
HEAVY OIL ENGINES.

The above Council invite TENDERS for MAKING, DELIVERING, SETTING to WORK and MAINTAINING for a period of six months, at their Waterworks Pumping Station at Ingatestone, Essex, of :—
TWO HEAVY OIL ENGINES, together with SHAFTING and other INCIDENTAL WORK.

Drawings and a copy of the general conditions, form of Tender, and specification may be obtained upon application to the undersigned, upon deposit of £1, which will be returned after the receipt of a bona fide Tender.

Tenders, sealed and endorsed "Oil Engines," must be delivered to the Clerk to the Council, Mr. Arthur S. Duffield, 96, High-street, Chelmsford, on or before 18th April, 1927.

The Council do not bind themselves to accept the lowest or any Tender.

JAMES DEWHIRST, A.M.I.M.E.,
Engineer.

Waterloo-lane, Chelmsford,
29th March, 1927. 5156

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

THE POSITION of ASSISTANT SUPERINTENDENT ENGINEER for Fleet of Tank Steamers, Box P2857, has now been FILLED. 5139 A

WANTED, ASSISTANT CHEMIST for Engineering Laboratory.—Write, stating qualifications, experience, age, references, and salary required, to ALFRED HERBERT, Ltd., Edgwick Works, Coventry. 5133 A

WANTED, CHIEF ASSISTANT, Foundry Commercial Department; knowledge estimating, accountancy, export, and office organisation; previous experience Cast Iron Pipe Trade essential.—Write, stating age, experience, salary, &c., to "PERSONAL," Commercial Manager, The Staveley Coal and Iron Co., Ltd., Staveley Works, near Chesterfield. 5154 A

WANTED for India, ASSISTANT ENGINEER for Steel Works Power Plant; technical graduate, with mechanical training and good knowledge electrical equipment, practical experience in Steel Works' Power Plant, including Powdered Fuel, desirable and knowledge Steam and Gas-fired Boilers, Turboblowers and Generators essential. Approximate monthly salary Rs. 1500, passage out and home.—Write, Box Z.T. 937, c/o Deacon's Advt. Agency, Fenchurch-avenue, London. 5142 A

WANTED for Steel Works Research in Sheffield, ASSISTANT METALLURGIST. State age, training, experience, and salary required.—Address, 5132, The Engineer Office. 5132 A

CRANE ENGINEER, Accustomed to Controlling the design of Crane Work, to Assist Managing Director with technical correspondence, estimating and interviewing clients. A good salary will be forthcoming to a competent individual, and only applications from such will be entertained. North of England. Age, full particulars of experience, and remuneration expected.—Address, 5118, The Engineer Office. 5118 A

ENGINEER, Age 25 to 30, Public School and University, with degree in mechanical and electrical engineering, also shop experience, for staff appointment to Textile Firm in Manchester. Confidential.—Address, P3007, The Engineer Office. P3007 A

FOUNDRY SUPERINTENDENT WANTED, to Take Charge of Ironfoundry in N. Midlands, with output of 50/60 tons per week. Must be practical man with metallurgical training, and have satisfactory educational qualifications and experience.—Address, stating age, salary required, when at liberty, &c., and, if possible, enclosing photograph, which will be returned, 5136, The Engineer Office. 5136 A

MECHANICAL ENGINEER.—A Young MAN of good education and address WANTED in Works Manager's Office of large modern Printing Works. Possibility of having charge eventually of whole of plant.—Address, stating age and fullest particulars of experience, both practical and technical, and commencing salary required, 5166, The Engineer Office. 5166 A

SALES MANAGER REQUIRED for Engineers' Stores Business in London. State fully experience, age, salary required.—Address, P3012, The Engineer Office. P3012 A

THE STANTON IRONWORKS COMPANY, Limited, near Nottingham, REQUIRE the FULL-TIME SERVICES of a REPRESENTATIVE to keep touch between England and their Agents in each of the South American countries.—Apply in writing, in confidence, setting out previous experience, to the MANAGING DIRECTOR, c/o the above. 5069 A

TRAVELLER REQUIRED for Continental Steel Merchants. Knowledge of German an advantage. State salary required and experience.—Address, P3001, The Engineer Office. P3001 A

WANTED, First-class MACHINE TOOL DRAUGHTSMAN, age 28-35. State wage and experience.—Address, 5134, The Engineer Office. 5134 A

WANTED, DRAUGHTSMAN, with Good Knowledge of Automobile Work with special reference to Commercial Vehicles.—Address, 5131, The Engineer Office. 5131 A

WANTED, First-class DRAUGHTSMEN. Must be capable of designing Electric Motors, Switches, Transmitters, &c. State age, experience, and salary required.—Address, 5162, The Engineer Office. 5162 A

WANTED IMMEDIATELY in London, DRAUGHTSMAN, with experience in design of complete Steam Power Stations; electrical knowledge desirable.—Address, stating age, experience, salary expected, and when free, P2997, The Engineer Office. P2997 A

WANTED, JUNIOR DRAUGHTSMAN, One with experience in Conveyor Work preferred, but not essential. Must be quick and accurate. State experience, age, and salary required.—Address, 5141, The Engineer Office. 5141 A

SITUATIONS OPEN (continued)

WANTED, JUNIOR DRAUGHTSMAN, with Experience in Centrifugal Pumps. State age, wage, and experience.—Address, 5126, The Engineer Office. 5126 A

DRAUGHTSMAN.—BUMSTED and CHANDLER, Ltd., Hednesford, Stafford, have a VACANCY for a smart JUNIOR DRAUGHTSMAN, with experience upon Steam Engines, Fans, Centrifugal Pumps, Light Structures, or similar classes of work.—Applications, addressed "DRAUGHTSMAN," should state age, previous employers, salary required, and when at liberty. 5123 A

DRAUGHTSMAN, Capable, with Knowledge of Acetate Plant and Lay-out of Chemical Machinery. Perm. sit., London district.—Address, giving fullest particulars of past experience and salary reqd., 5159, The Engineer Office. 5159 A

DRAUGHTSMAN REQUIRED IMMEDIATELY, with experience in Off-set Printing Machinery. Give full details of experience, age, and salary required.—Address, 5125, The Engineer Office. 5125 A

DRAUGHTSMAN REQUIRED. Must be a Really first-class man, quick and accurate worker, capable of original design of complicated Pressure Vessels to boiler shop practice, General Machinery, Steam Plant, and Lay-outs. State full particulars of experience, age, and salary required.—Address, P3011, The Engineer Office. P3011 A

DRAUGHTSMAN REQUIRED, with Experience of detailing Constructional Steel Work for London Steel-framed Buildings and some knowledge of design.—Apply by letter, H. YOUNG and CO., Ltd., Thornycroft House, Smith-square, S.W. 1. P2992 A

DRAUGHTSMAN WANTED by Large Engineering Firm in the City, with experience of Pipe Work Lay-out.—Address, stating age, salary, and experience, 5152, The Engineer Office. 5152 A

EXPERIENCED LOCOMOTIVE DRAUGHTSMAN for Works in Lancashire.—Address in confidence, stating age, experience, and salary required, 5030, The Engineer Office. 5030 A

FIRST-CLASS DRAUGHTSMAN WANTED, Accustomed to the design of Structures of all classes, with and without machinery. State age and experience.—Address, 5135, The Engineer Office. 5135 A

SITUATIONS OPEN (continued)

JUNIOR DRAUGHTSMAN WANTED. Preference will be given to a man who has had good workshop experience in General Engineering Works.—Address, 5129, The Engineer Office. 5129 A

SENIOR DRAUGHTSMAN REQUIRED, 30 Miles from London. Full knowledge Conveying Plant and experience Package Work essential.—Address, stating salary and experience, P2994, The Engineer Office. P2994 A

STRUCTURAL DRAUGHTSMAN REQUIRED by British Firm in India. Must have had good technical training, be able to work out stresses, prepare designs, estimates and detail drawings of Roof, Bridge and General Structural Steel Work. Must be a bachelor, age 22 to 27.—Apply, stating age and particulars of experience, to Z.A. 942, care Deacon's Advertising Agency, Fenchurch-avenue, E.C.3 5143 A

ARTESIAN WELL-BORING FIRM in London REQUIRE an experienced FOREMAN WELL BORER, with knowledge of Rod Percussion, Cable Percussion and Steel Shot Rotary Drilling, for ADMINISTRATIVE POSITION. Applicants should be between the age of 30 and 50, and should write giving full details of their experience. Only first-class men will be considered.—Address, 5052, The Engineer Office. 5052 A

PATTERNMAKERS.—Permanency for Capable Men. District rate.—Apply, P. J. SMITH, 2 and 2a, Wynyatt-street, Goswell-road, E.C. 1. 5151 A

SITUATIONS WANTED

APPRENTICED ENGINEER SEEKS CHANGE, Age 29, single. Experience motor and general engineering, experimental work; capable charge hand or foreman.—Apply, A. G. HOVERS, 112, Croydon-road, Erdington, Birmingham. P2993 B

AUTOMOBILE DESIGNER, Accustomed to Control and organisation, with exceptional technical and practical knowledge and experience in latest practice of heavy passenger and commercial vehicles, especially six-wheelers, DESIRES POSITION of responsibility and trust.—Address, P2996, The Engineer Office. P2996 B

SITUATIONS WANTED (continued)

CIVIL ENGINEER, 16 Years with Contractors, SEEKS PERMANENCY with Consulting Engineer, railways, roads, tunnels, ferro-concrete, &c. Control of men. Free by giving one month's notice.—Address, P3008, The Engineer Office. P3008 B

COMMERCIAL ENGINEER. Having 25 Years' experience, well known amongst large engineering firms, DESIRES POSITION of TRUST with reliable Export House specialising in Machinery and Machine Tools. Can give highest references as to character and ability.—Address, P3005, The Engineer Office. P3005 B

DO YOU WANT A "LIVE" MAN?
A MESSAGE TO THE FOUNDRY AND ALLIED INDUSTRIES OF GREAT BRITAIN.

Where can the man be found who fits your conception of a real Commercial Foundryman and Engineer? A man who understands the problems and possibilities over and above balance sheets, and has such a command of the principles of foundry work and its everyday instruments and practices as to apply a correct place to your business.

ADVERTISER, having the qualifications which fill the above, is OPEN to CONSIDER a POSITION with a firm which is progressive enough to realise that a man's salary should be in accordance with his merit as a worker and a profit-maker.

Address replies, P3017, The Engineer Office. P3017 B

ENGINEER (25), B.Sc., Six Years Workshop, D.O., and estimating, two years modern sales office, used to correspondence and office routine, REQUIRES progressive POSITION.—Address, P2995, The Engineer Office. P2995 B

ENGINEER (43), B.O.T. Cert., SEEKS CHARGE of PLANT; 20 years' exper. erection and maintenance steam and electric; excellent refs.—Address P2998, The Engineer Office. P2998 B

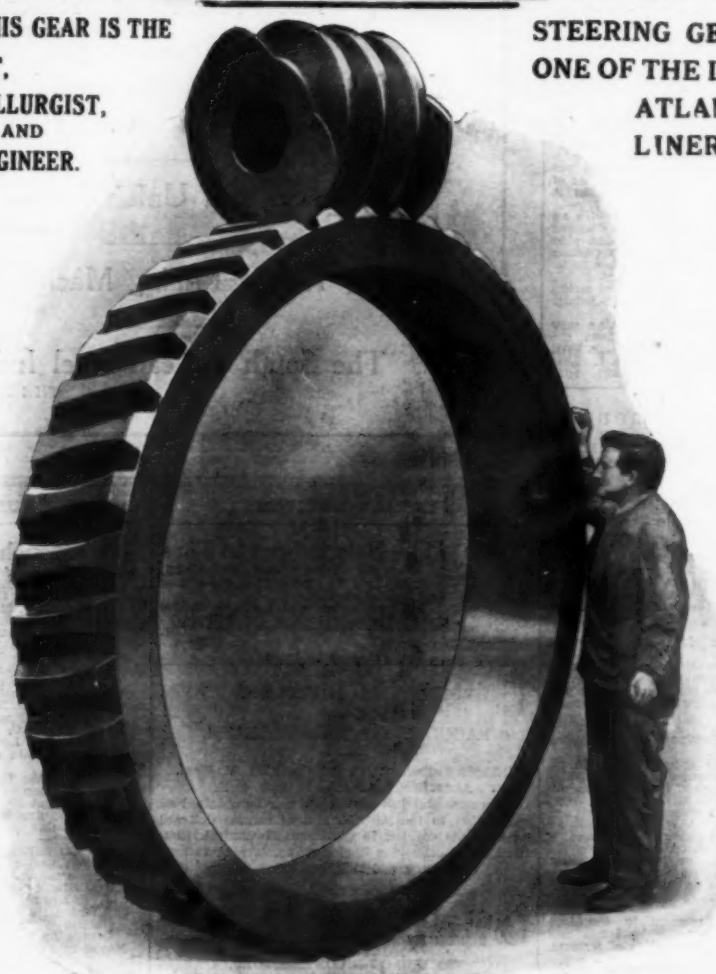
ENGINEER (34), Married, 18 Years' Marine and factory experience, engines, boilers, electricity, pumps, &c., B.O.T. Certificate, SEEKS POSITION as Maintenance or Factory Engineer. Excellent references.—Address, P3006, The Engineer Office. P3006 B

For continuation of Small Advertisements see page 3.

HOLROYD

BEHIND THIS GEAR IS THE CHEMIST, METALLURGIST, AND ENGINEER.

STEERING GEAR FOR ONE OF THE LARGEST ATLANTIC LINERS.



"HOLROYD" WORM GEARS
OF EVERY SIZE AND PURPOSE.
JOHN HOLROYD & CO., Ltd., Milnrow, Lancs.
MAKERS OF MACHINE TOOLS TO INCREASE PRODUCTION.

A Seven-Day Journal

A Steel Works Anniversary.

TO-DAY—Friday—is the seventy-fifth anniversary of the foundation of Samuel Osborn and Co., Ltd., Clyde Steel Works, Sheffield. The founder, the late Mr. Samuel Osborn, was born at Eccleshall, just over a hundred years ago. Trying his hand first in the drapery trade and then with a firm of cutlery manufacturers, he turned eventually to steel making, and on April 1st, 1852, opened a small factory, at Brookhill, Sheffield, for the manufacture of files. By 1856 he was the owner of a six-hole crucible furnace for melting and refining his own steel. Shortly afterwards he expanded his activities and began the manufacture of a wide range of steel articles, including small tools, hammers, agricultural implement knives and bayonets. In 1864 he introduced file-cutting by machinery, a bold step taken in face of much opposition and discouragement, but one that was subsequently to be fully justified. In 1867 he took into partnership his brother-in-law, Mr. W. H. Fawcett, and a few years later was joined by Mr. J. E. Fawcett. By 1868 the company was firmly established at the Clyde Steel Works, where it engaged not only in the converting and refining of steel, but in the manufacture of laminated springs, railway material and steel castings. In 1871 began the association of Mr. R. F. Mushet with the firm, and the development of that gentleman's discovery of the self-hardening property given to tool steel by the addition of tungsten. It took twenty years of hard work to convince engineers of the merits and advantages of the new tool steel. In 1874 a variety of outside causes brought the firm into difficulties, and led to the filing of a petition in bankruptcy. Many offers of help were received, including one from the firm's workpeople to submit to a reduction of 5 per cent. in their wages for two years. Other arrangements were, however, made, the business was soon regained, and by 1884 all the creditors had been paid off. Mr. Osborn died in 1891 in the same year as Mushet. From that date until the present the firm has continued to expand and develop its products, notable events being the introduction of high-speed tool steel in 1900 and of a variety of manganese steel in 1906.

The Protection of Gas Cylinders.

WE have received this week a letter from the secretary to the Department of Scientific and Industrial Research, in which particulars are given of a modification to be made in the rules governing the design of gas cylinders. The recommendations made in the first report of the Department's Gas Cylinders Research Committee, published in 1921, included a clause which stated that such cylinders need not be protected by coir mats if their valves were adequately protected by screwed-on caps. This clause has been under review on the ground that it does not discriminate between compressed gases, such as oxygen, which are relatively harmless, and gases which are dangerous because of their poisonous or inflammable nature. The clause, moreover, is open to the interpretation that a coir covering is regarded as being a suitable protection for the valve. It has been decided to revise the clause to remove these grounds for criticism. It is now to be specified that any cylinder containing a poisonous or inflammable gas should, when not in use, have its valve completely protected. If the valve does not lie wholly below the level of the cylinder body, a stout metal cap or cover should be provided for the valve, the design being such that the cap is at no point in close proximity to the valve or valve body. Cylinders, it is added, need not be protected by coir mats. The new clause is not intended to extend to liquefiable gases. A separate report on cylinders for such gases is shortly to be prepared.

The Last of the Surplus War Stores.

IN June, 1923, the Government, having disposed of the bulk of its assets in the way of surplus war stores, decided that the most profitable means of liquidating the residue was to accept an offer to handle the remaining stores on a commission basis, which had been made by George Cohen Sons and Co., Ltd., machinery merchants, in combination with Sir W. G. Armstrong-Whitworth and Co., Ltd. The George Cohen and Armstrong Disposal Corporation was immediately formed, with Mr. A. W. Beuttell as general manager, and at once the task of disposing of the equipment and contents of some 450 war factories and depôts was begun. The material remained the property of the Government, the Corporation acting merely as an agent and receiving a commission and its expenses. Difficulty with purchasers of the material was avoided by an undertaking on the part of the agents that their respective firms should be entirely excluded from the right to purchase material from the Corporation. The contract has now been completed. The maximum number of staff engaged on the contract at any one time did not exceed 150, but the work gave employment to large numbers of workpeople on the recovery and rendering marketable of the assets. The material disposed of by the Corporation was very diverse in its nature. It included between 500 and 600 main line locomotives, wagons, &c., over 100 works and fireless locomotives, boilers and economisers; 150 generators and generating sets; 1500 electric motors; 358 cranes, overhead travellers, &c.; 500 weighbridges and weighing machines, in addition to machine tools, chemical and refrigerating plant, rolling mills, gas producers and so on. Forty-five thousand tons of heavy and light rails and 22,000 tons of cast iron and steel piping were recovered, in addition to 50,000 tons of ferrous and 7500 tons of non-ferrous scrap material. Even medical stores were included in the Corporation's contract. These medical stores filled a building 700ft. long by 60ft. wide, and were sold on wholesale and retail lines in amounts ranging in value from £150 down to a few pence. Only one bad debt—a matter of £7—was incurred during the execution of the contract, and only one law suit—decided in the Corporation's favour—had to be undertaken. Many people will be glad to learn that the last of the surplus stores left over by the war have been disposed of by the Government, but it should, perhaps, be remarked that re-sales by the original purchasers may for some time to come continue to exert an influence in various markets.

The Electricity Board.

A FEW days ago it was announced that Mr. Archibald Page, who has been closely associated with the electricity supply industry for twenty-eight years, had been appointed chief engineer and manager of the Central Electricity Board. He was an electricity commissioner from the time of the establishment of the Commission until 1925, when he resigned to become a director and general manager of the County of London Electricity Supply Company. Before joining the Electricity Commission he was general manager of the Clyde Valley Power Company, having previously been deputy city electrical engineer of Glasgow. He is a native of Alloa, Clackmannanshire, and was educated at Dollar and Edinburgh. Mr. Page is a vice-president of the Institution of Electrical Engineers, and a vice-chairman of the Scottish Centre of the Institution. Mr. J. R. Brooke, late Permanent Secretary of the Ministry of Transport, has been appointed secretary and Mr. D. W. Coates, of D. W. Coates, West, Grimwood and Co., chartered accountants, has been appointed accountant to the Board.

German Naval Construction.

THE light cruiser Königsberg, the keel of which was laid at Wilhelmshaven on April 12th, 1926, was launched on Saturday last, March 26th, in the presence of the Prussian Prime Minister and other officials. She is the second German post-war cruiser to take the water, the first, which was named the Emden, having been launched in January, 1925. She was completed in the late autumn of that year, and is now making a cruise round the world. A third vessel, which will probably be named Karlsruhe, is on the stocks at Wilhelmshaven; a fourth is also under construction; and a fifth ship is to be begun under the Estimates for the current year. The Königsberg is described as an improved Emden, differing from the prototype in minor details, but having approximately the same dimensions. The length overall is 508ft., the displacement 6000 tons at normal draught, and the designed speed 29 knots. Electric welding was extensively employed in the construction of this vessel, as in that of the Emden, and it is claimed that a marked saving in weight of hull has resulted from the adoption of this system. The armament is reported in Press messages to consist of nine 5·9in. guns, but eight is the more probable number, twin-mounted on the centre line at bow and stern, with eight 19·7in. torpedo tubes disposed on the broadside. It will be observed that Germany has conformed to the Versailles Treaty by limiting the displacement of her new cruisers to 6000 tons, and in laying down only such ships as are required to replace vessels which have exceeded the specified age of twenty years. Other new construction comprises eleven destroyers of 800 tons and a small torpedo boat. The proposed conversion of the old battleship Zähringen into a wirelessly-controlled target ship has not been sanctioned by the Reichstag.

The Future of the World's Shipbuilding Industries.

IN a memorandum which has recently been published as part of the material for the coming International Economic Conference arranged by the League of Nations, some interesting figures which bear upon the post-war shipbuilding development and the probable future of the shipbuilding industry are presented. It is pointed out that whereas in 1913 the total world tonnage was 47,000,000 tons, in 1925 it had risen to over 64,500,000 tons. The real world demand is probably not more than 55,000,000 tons, and for some years the maximum production figure for the world's shipyards is likely to remain at between 1,500,000 and 2,500,000 tons. The memorandum states that the immediate future of the industry in each country will depend on the rate of the scrapping of old ships and the general demand for new tonnage and new types of vessels. New construction has largely been influenced by the extended introduction of motor vessels and larger steamers and motor ships. The recent increase in the tonnage of oil tankers is noted. In 1926 it had grown to 5,665,000 tons, or about four times that of the year 1914. The bulk of the shipping trade decreased in 1925 to 15·6 per cent. below that of 1913, and, generally speaking, tramp tonnage especially tends to become less profitable. In a section of the memorandum which deals with prices and freights, it is stated that the cost of ships has changed but slightly, the figure for Great Britain being given for 1926 as an increase of 3·96 per cent. only, as compared with the building prices of ships in 1913. The present low freight rates are explained as being caused by the surplus tonnage, and even a revival of trade, it is stated, would not probably bring about a permanent improvement. It would merely tend to bring in again the ships which are now laid up, and would so destroy the normal relation between shipping and volume of trade upon which steadiness depends.

Limitation of Navies.

IN view of the dispatch of formal invitations from Washington and their acceptance by the Governments concerned, it is now certain that a conference on the limitation of naval armament between the British Empire, the United States and Japan, will meet at Geneva this summer, probably early in June. Although this meeting has been convened by the United States, the initiative in drawing up the agenda will not be left to that country, for it is officially announced that the British Government has already submitted proposals aiming at the restriction of future naval development. The *personnel* of the British delegation has yet to be determined, but in accordance with the Washington Conference precedent the First Lord of the Admiralty and the senior naval member of the Board are expected to attend. Japan's chief naval representative will be Vice-Admiral Kobayashi, who served as naval *attaché* in London after the war. France and Italy declined to participate in the new conference, and were subsequently invited to send "observers," but the latest reports from Paris and Rome foreshadow a definite refusal of this proposal by both countries. Having regard to the inter-relationship of naval armaments, the abstention of these important Powers promises to give the forthcoming discussion at Geneva a purely academic character. Hopes are expressed in naval circles that the opportunity will be taken to adjust differences of opinion which have arisen out of the Washington Treaty, particularly on the subject of ship reconstruction, with special reference to changes in armament. It will be recalled that the U.S. Congress recently authorised an increase in the turret-gun elevation of certain American battleships which the British Government holds to constitute an infraction of the Treaty.

Grants to Research Workers and Students.

THE statistics of grants made to individual research workers and students-in-training contained in the report, issued at the end of last week, on the working of the Department of Scientific and Industrial Research during the year 1925–26, once again reveal a great disparity in the assistance accorded to the different branches of science. Taking the totals of the three categories, students' maintenance allowances, research workers' and research assistants' personal grants, and grants for equipment and laboratory assistance, we again find chemistry well at the top of the list with 136 grants. Biology comes second with 44 grants, followed closely by physics with 41. Engineering occupies fourth place with 20, and is followed by geology and mineralogy with 13, mathematics and astronomy with 11, and metallurgy with 10. Aeronautics is at the foot of the list with no grants. The sum expended on these 275 grants was £37,198, representing an average value of £135 for each. Of the 275 grants, 212 represent maintenance allowances to students, and of these maintenance allowances 108 were made to students of chemistry. The Advisory Council, the body responsible for the policy of awarding grants and presumably exercising control over the carrying out of that policy, comments on the preponderance of the assistance given to students of chemistry. It expresses the opinion that at present far too many men are encouraged to specialise in chemistry. Whenever, it says, a post for chemical research is advertised, very large numbers of applications are received. On the other hand, the demand for men who combine a study of chemistry with a study of other subjects, such as agriculture or botany, outstrips the supply. The Council also notes a scarcity of men capable of applying general physics to industry and states that students of economic botany have no difficulty in obtaining attractive and well-paid employment. The report seems to hint that in the future increased differentiation is to be made between the various branches of scientific research and between the claims of pure science and of industry.

The World's Future Supplies of Liquid Fuels.

By JOHN B. C. KERSHAW, F.I.C., F.S.S.

No. V. (*Conclusion*)*.

THE SYNTHESIS OF LIQUID FUELS FROM VEGETABLE AND OTHER OILS AND FROM CELLULOSE.

The author in the previous articles has described only the processes for the production of synthetic liquid fuels, based upon the use of coal as raw material. In this final article of the series, he will discuss the methods that have been devised and tried for the production of synthetic liquid fuels from oils of vegetable or animal origin and from cellulosic materials. It may be admitted that the prospect of any immediate industrial development of these processes is slight; and that at the present time coal is a much more promising raw material than vegetable matter, for the synthesis of liquid hydrocarbons and substitutes for petrol.

Vegetable oils and cellulosic materials may, however, become of considerable importance in the future, as the following extracts indicate:—

So far as our knowledge goes, it is vegetation, and vegetation only, that has the power of storing sun energy in such a form that it can be reproduced and converted into power when we require it. The extent to which this action takes place is but limited, and Helmholtz has calculated that of the energy exerted by the sun's rays on any area of growing vegetation only one fifteen-hundredth is fixed in doing chemical work. Small as this fraction is, it is an important asset in the future of the world, and although gravity in the form of water power will be an important source, it is to the growing plant that we must turn for the main supply of energy required in the "fuelless" world of the future.

It is quite clear that existing conditions would render impossible the conversion of vegetation (by natural forces) into any forms of fuel, to which we are accustomed. Apart from the fact that the vegetation which formed our coal measures grew under entirely abnormal conditions, the conversion of cellulose into peat, lignite and coal, is an operation which requires a combination of time, temperature and pressure impossible now to attain; while, save to a very limited extent, timber takes too long for its growth to be more than an insignificant adjunct.—*From "Liquid and Gaseous Fuels," by Vivian Lewes, F.I.C. Second edition. Constable and Co.* 1921.

In the tropical portions of the Empire the energy of the sun is exercised under the most favourable conditions, and here there are vast quantities of vegetation of rapid growth, forming an enormous reservoir of the sun's radiant energy. If a cheap and simple process, either chemical or bacteriological, were available, and could be applied commercially upon a very large scale, tropical vegetation would afford a practically inexhaustible reservoir of power alcohol.—*From "Fuel for Motor Transport," Interim Memorandum by the Fuel Research Board*, 1920.

The study of the genesis of petroleum is of more than academic or geological interest; for when we know the ways in which Nature has produced such a valuable substance, we may be in a position to duplicate the processes or improve upon them. . . . It may turn out that one type of petroleum at least has its origin in vegetable matter, that was converted into marsh gas and finally into higher hydrocarbons.

The formation of hydrocarbons from vegetable material, through the action of bacteria or other agencies, will some day be studied, and the results may lead to important industrial developments. Heptane is produced by a certain type of tree and other hydrocarbons have been shown to have a vegetable origin. Some day we shall know more of such chemical processes.

The world must eventually turn for help to the Tropics, with their limitless supply of energy in the form of sunlight; and something to do the work now done by petroleum will be made from the vegetable material so abundantly and quickly supplied with energy from the sun.—*From "The Future of the Chemistry of Petroleum," by J. F. Norris. "Industrial and Engineering Chemistry," October*, 1926.

Patents have been taken out recently, covering the production by direct bacterial fermentation, of acetic acid and alcohol from vegetable materials of little or no value for other purposes. Methane, hydrogen and carbon dioxide are also obtained as by-products, but details are lacking as to the yields and as to the conditions under which they are respectively produced. In the event of this process developing on commercial lines, it might have interesting possibilities. . . .

The necessity of a supply of methane which could be produced on the spot has led to some further work on the above process at Nobel's factory in Ayrshire. This process is in the initial stage, but there are indications of its being possible entirely to ferment cellulose into practically nothing but methane and carbon dioxide. Here, again, if such a process can be developed upon a commercial scale, it offers possibilities in connection with the synthetic production of formaldehyde and methyl alcohol. —*From Opening Address by Sir F. Nathan during the discussion on the "Action of Bacteria on Cellulosic Materials," Soc. Chem. Ind., London Section, May 7th*, 1923.

Vegetable Oils.

The Mailhe Process.—Professor A. Mailhe is a French chemist, who for some years past has been working upon the problem of transforming the oils obtained from the seeds of tropical plants and fish oils into hydrocarbons resembling petroleum. He now claims to have attained success in this transformation, and he considers that oils of vegetable and animal origin will provide a very valuable source of liquid fuel, when the natural petroleum resources of the world are exhausted.

Mailhe's process is based upon the dehydration and polymerisation of vegetable oils in the presence of zinc chloride; but although that salt yields the best results, calcium and other chlorides of the same group may be employed in place of zinc. The early experimental work was carried out with rape seed oil, but pea-nut oil, castor oil, shark oil and whale oil have all been treated, and have yielded products very similar to those obtained from rape seed oil.

As described in British patent No. 218,278 of June, 1923, the process is carried out by heating the oil or fatty acid in a copper or iron boiler, provided with a condensing column, this heating being effected in company with one or more metal oxides or chlorides which serve as dehydrating or polymerising agents. Zinc chloride can be employed during the subsequent treatment, and the heating operation may be performed under pressure at temperatures between 350 deg. and 500 deg. Cent. The liquid which comes over and is condensed, is separated from the water, and after neutralising with a dilute soda solution it is fractionated. The heavier oils, which remain in the still, are finally removed from it by the use of superheated steam. According to an article by Mailhe published in *Journ. des usines a Gaz*, vegetable and animal fats, tallows and greases can all be decomposed by heating with 5 to 10 per cent. of the chlorides to 380 deg. Cent., and then by stages up to 450 deg. Cent. The first portion of the distillate contains liquid or solid fatty acids, which must be returned to the still for complete decomposition, and some undecomposed ketones will be present in the final product. These are said not to affect the burning qualities of the fuel, when it is used for internal combustion engines and engines of the Diesel type.

As an example of the results obtained, the experiments made by Mailhe with pea-nut oil, and recorded in *Chaleur et Industrie*, Vol. V., may be quoted. A mixture of 300 grammes of pea-nut oil and 50 grammes of anhydrous magnesium chloride was heated gradually in a copper kettle, provided with a delivery tube attached to a condenser, up to the boiling point of the liquid, which at first lay between 300 deg. and 350 deg. Cent. A small amount of fatty acid was carried over at this stage by the aqueous vapour, and the distillation proceeded regularly until a temperature of 450 deg. Cent. was attained. A continuous production of gas containing hydrochloric acid was noted during this stage of the process, and was due to the formation of a magnesium oxychloride. The liquid obtained by this first distillation was redistilled, and that portion with a boiling-point above 210 deg. Cent. was again put back into the kettle in order to complete the decomposition of the fatty acids and ketones. The distillate finally obtained was treated with dilute sodium hydrate, and was then washed with water. It gave a total yield of 198 grammes, equivalent to 66 per cent. of neutral transformation products. On being separated into its constituents by fractionation, it was found to consist of a mixture of hydrocarbons of the CH_4 series and of the C_2H_4 series, and yielded petrol, illuminating oil, heavy oils, lubricating oils, and a product similar to vaseline, which could also be converted into a liquid product by heating with fused zinc chloride.

Rape oil when similarly treated with a 10 per cent. solution of zinc chloride yielded water, $CH_2 : CH\text{-}CHO$, and volatile products. The distillate was acid, and the fractions boiling between 110 deg. and 310 deg. Cent. were found to contain acetylenic and ethylenic products. When the residue boiling above 310 deg. Cent. was treated again with zinc chloride, viscous oils and vaseline were produced. In another article, published in the *Journ. des usines a Gaz*, Vol. 46, Mailhe states that the liquid products obtained by his process from pea-nut oil resemble Borneo petroleum in odour, and that when neutralised and hydrogenated a mixture of formic and cyclic hydrocarbons can be obtained, with considerable amounts of benzene, toluene, and xylene.

Sato has been carrying out experimental trials in Japan with a process very similar to that of Mailhe, using soya bean oil with a calcium salt for its decomposition. The yield of liquid products obtained in these trials was about 70 per cent. of the crude oil, and when distilled the liquid yielded 20·6 per cent. of a light oil, with a boiling-point below 150 deg. Cent.; 58·5 per cent. of medium oils, boiling between 150 deg. and 300 deg. Cent.; and 20·3 per cent. of heavy oils, with boiling-points above 300 deg. Cent. When the medium oil was refined with sulphuric acid it was found to contain 60 per cent. of unsaturated hydrocarbons, while the heavy oil contained about 5 per cent. of solid paraffins.

G. Gallo and R. Corelli, in the "Atti Congresso Naz. Chim. Pura Applicata," for 1923, page 257, have also described a method very similar to that used by Mailhe for the treatment of vegetable oils. In their work the oil was first decomposed by superheated steam in the presence of an alkaline earth, and the gaseous products were led over pumice stone, containing ferrous oxide, at a temperature of 550 deg. Cent. After this treatment the gases were passed over another layer of pumice stone carrying finely divided and reduced nickel, and at this stage hydrogen was introduced at a temperature between 200 deg. and 250 deg. Cent. The gaseous products of the reaction contained 33·5 per cent. of heavy hydrocarbons and 43·4 per cent. of saturated hydrocarbons, with small amounts of CO and CO_2. When condensed, a yellowish-brown oily liquid was obtained which was slightly fluorescent. This liquid yielded on fractionation 24·5 per cent. under 200 deg. Cent.; 41 per cent. between 200 deg. and 300 deg. Cent.; and 29·5 per cent. between 300 deg. and 350 deg., while the tarry residue only amounted to 5 per cent.

The latest contribution on the subject is contained in the *Journ.*, Soc. Chem. Ind., Japan, Vol. 29, 1926, in which Sato and Tseng describe the results of their experiments with soya bean oil and oxides or carbonates of the alkaline earth metals as decomposing agents. So far as the properties and yields of the compounds obtained are concerned there is not any great difference between the two methods, but when the same amounts of the agents are employed, magnesium produces an oil superior to that obtained by calcium. The carbonates of the metals require a longer time for their action than the oxides, but even in their case no considerable difference was found in the chemical composition of the distillate. Over 20 per cent. of the saponifying agent, based on the oil or on the fatty acids, is required for the distillation.

Should the Mailhe process ever be operated upon a commercial scale it will be necessary to take note of the fact that a Japanese patent was taken out in 1921, in the name of K. Kobayashi—No. 40,623—which apparently covers much the same process of producing liquid products from vegetable oils, the only difference being that an acid clay was employed in place of calcium or magnesium salts, and the temperature of distillation was somewhat higher than that used by Mailhe. Petroleum hydrocarbons, according to the patent, were produced on heating a mixture of vegetable oil with this clay, an oil with a specific gravity of ·818, and having a greenish fluorescence, was obtained by distillation. The total yield of liquid products was 55 per cent. of the raw material used, and when the liquid hydrocarbons were treated with sodium hydrate, sulphuric acid and water, and were fractionated in the same manner as petroleum, they gave 8·2 per cent. of petrol, specific gravity ·7382; 15·7 per cent. of illuminating oil, specific gravity ·8155; 32·1 per cent. of neutral oils, specific gravity ·8291.

Cellulose.

The extracts given at the opening of this article show that many authorities consider cellulose and cellulosic materials will ultimately be the raw stuff upon which we shall rely for our supplies of liquid fuel, and that in the course of time it will be the growing plant, rather than the fossilised remains of plants in our coal measures, which will supply the world's future requirements of petrol. At the present time several processes are in experimental use for the production of wood alcohol or methanol from pure cellulose by bacteriological action, and if this primary alcohol were a satisfactory substitute for petrol the theoretical side of the problem might be considered solved. Methanol, however, cannot be considered a satisfactory substitute for petrol, owing to its low calorific value per unit volume, and the problem now confronting the chemists who are working on cellulose is how to produce by bacteriological or chemical methods the higher alcohols of the paraffin series from cellulose at a reasonable cost. The latest results of the experimental work now being carried on are given below. The success which has attended these investigations so far indicates that ultimately the problem will be solved.

A. H. Lymn and H. Langwell contributed a paper to the discussion upon "The Action of Bacteria on Cellulosic Materials," held by the Society of Chemical Industry in London in 1923, in which they stated that stable manure, when hot, contains a bacillus which attacks every form of cellulose under either aerobic or anaerobic conditions. The ligno-celluloses, such as wood and jute fibre, and cuto-celluloses, such as cork, were attacked slowly unless the cellulose was first freed from combination. The best temperature for the growth was found to lie between 60 deg. and 68 deg. Cent., but the comparative tests were carried out between 20 deg. and 38 deg. Cent., as the rate of growth at this lower temperature was similar to, though not so rapid as, that at the higher temperature. A table was given showing the results obtained with cellulose from a large number of different sources, and in some of the tests from 300 lb. to 500 lb. of the raw material were employed. The yield of acetic acid varied from 22 up to 79·7 per cent., and of alcohol from 1·6 up to 27·6 per cent., the latter yield being obtained with sulphite pulp. Equations were given showing the probable course of fermentation in order to account for the products formed, and the authors stated that over-aeration will lead to oxidation of the primary products and to formation of CO_2 and H_2O. Heavily lignified cellulose, such as the wood and xylem of perennial plants, required to be made into chemical pulp in order to render the cellulose fermentable, while green plants only required mechanical treatment. With dry materials a preliminary boil with dilute sulphuric acid makes the pulping easier, and also hydrolyses the pentrosans and changes them into xyloses, which are fermentable.

W. R. Ormandy, in the course of the discussion on this paper, stated that there were processes being worked for the production of fermentable sugars from wood by means of which it was possible to obtain 300 litres of 100 per cent. alcohol from 1 ton of dried wood substance, and the present problem was not so much the production of alcohol at a price which would compete with petrol now, but at a price which would be competitive in the course of a year or two.

H. Langwell, in reply to the discussion, stated that sometimes there were difficulties met with when fermenting impure celluloses, but with pure material fermentations of 8000 litres could be carried out with great regularity. The final products could be changed without changing the organisms, and one could produce at will, in the course of a few hours, either acetic acid and methane or lactic acid.

C. G. Schwalbe and R. Schepp, in the German "Berichte" for 1924, have published the results of some researches they have carried out upon the action of concentrated solution of magnesium chloride and

* No. IV. appeared March 25th.

SUSPENSION BRIDGE OVER THE RIVER DELAWARE

FIG. 25—CAMDEN APPROACH TO THE BRIDGE

zinc chloride on cellulose and other cellulosic materials. They state that products very similar to coal can be produced at relatively low temperatures, and that hydrochloric acid is produced as a by-product of the reaction. This reaction they consider to be most probably an hydrolysis of the cellulose to dextrose followed by carbonisation of the latter. The results obtained with zinc chloride gave a coal-like substance having a lustre like anthracite, but on heating it with hydrochloric acid it lost its lustre and became similar in appearance to the product obtained with magnesium chloride. As the result of their experiments, they conclude that the substances obtained from cellulose by heating with concentrated salt solutions resemble brown coal or lignite in composition, but are not completely identical with this natural product.

A. C. Thaysen, in a recent issue of *Fuel*, has discussed the action of bacteria on cellulose, and has formulated the theory that the formation of coal in past ages from vegetable materials was probably caused by bacterial decomposition. The classification made by Van Iterson of the bacteria which cause cellulosic decay into four groups ought to be preceded, he considers, by one dividing these cellulose-destroying organisms into two groups, namely:—(1) Bacteria-decomposing cellulose and hemi-cellulose only; and (2) bacteria-decomposing cellulose, hemi-cellulose and ligno-cellulose, and including moulds, the aerobic bacteria of Hutchinson, and other types.

According to Thaysen, the conversion of pentosans gives acids or alcohols depending upon whether the medium is acid or alkaline, and it is important to note that the accumulation of acids will prevent the complete destruction of the ligno-celluloses.

Alcohol and Sugar from Sawdust, &c.

Referring, finally, to the chemical processes for the production of alcohol and sugar from semi-tropical produce and from sawdust and wood waste, reference may be made to a method based upon the researches of Willstätter, who first showed that cellulose, with the aid of concentrated hydrochloric acid could be converted into sugar by hydrolysis. Dr. Bergius, whose process of hydrogenating coal for the production of liquid hydrocarbon was described in the third article of this series, has also been working upon this problem, and has been conducting experiments on a factory scale with the Willstätter process.

According to the latest reports, a plant has been erected at Geneva by the International Sugar and Alcohol Company, of London, and the saccharification process elaborated by Dr. Bergius is to be operated there upon a commercial scale. The wood is first dried in a large rotary drum, and is then brought into contact with concentrated hydrochloric acid in a counter-current diffusing chamber. The concentrated syrup thus obtained is dried in a spray apparatus, and the grey powder finally obtained consists of a wood sugar containing only small amounts of hydrochloric acid. It is being employed in Germany for cattle feeding purposes. The gases produced during the reaction contain acetic and hydrochloric acid, and as these can be recovered, the cost of the process depends chiefly upon the cost of the wood. At Geneva sawdust and waste wood are employed in a finely divided form, and when desired alcohol can be produced from the sugar by a fermentation process. It is stated that a yield of 30 litres of alcohol per 100 kilos. of wood can be obtained by the new process, or three times the amount yielded by the earlier processes of wood saccharification and fermentation. The process is considered to have a great future in districts such as Western Canada and the Western States of America, where enormous amounts of wood waste are produced in the lumber industry and wood-working factories.

This final article of the series may be concluded by quoting some remarks made by Professor Ling at the annual general meeting of the Birmingham Section of the Institute of Chemistry in November last. Professor Ling, as chairman of the section, delivered an address upon "Chemistry as a Career," in the course of which he stated that the fermentation industries offered a great prospect for young chemists:

> Not only was there scope in the great industries of malting, brewing and the distillation of potable alcohol, but even more in the manufacture of industrial alcohol and power alcohol, which sooner or later must take the place to a large extent of petrol. With regard to the raw materials from which alcohol could be obtained by fermentation, the British Empire furnished limitless sources, and even in this country there were possibilities of utilising for this purpose materials which were now counted as waste. But fermentation by yeast was not the only type of fermentation which offered practical possibilities, as there were certain forms of bacteria which were likely to be harnessed in the future for the fermentation of cellulose and other polysaccharides.

Delaware River Suspension Bridge, U.S.A.

No. V. (*Conclusion*).*

Cable Anchorages.—In each anchorage structure the two cables, coming in at an angle of about 8 deg. above the horizontal, are diverted downwards at about 45 deg. below the horizontal by passing over saddles on a steel gallows frame, as shown previously in Figs. 2 and 7 *ante*, with its saddle in Fig. 17 *ante*. This frame, inclined backwards from the river at about 45 deg. above the horizontal, is seated upon a massive block of masonry carried by the foundation piers already described. It is 76ft. long and consists of two massive posts spaced 89ft. between centres to correspond with the cable spacing, and having a cross section of 7ft. by 8ft., built up in cellular form like the columns of the main towers. These posts are connected by transverse and diagonal members, and each is seated in a cast steel shoe anchored to the inclined face of the masonry. The shoes are grouted in place to give a uniform bearing. These anchor frames are built up of silicon steel, of the same grade as that used in the towers.

The cast steel saddles on these anchor frames—Fig. 17 *ante*—are similar to those on the towers, but are covered with ¾in. steel plate to protect the cables and are embedded in concrete nearly to their full depth. In the saddle the cable has a radius of 14ft. 6in. on its centre line. Beyond the saddle, the sixty-one strands of wires are separated in fan shape, and each is looped around a grooved block or shoe, through which passes a steel pin, the ends of which are held in the heads of a pair of eye-bars. From the anchorage saddle to the point where the strands separate, the cable is held in a cast steel sleeve made up in bolted sections and taking a bearing against the saddle. The lowest portion of this sleeve forms a flaring bell-mouth or funnel over the diverging strands—see Fig. 17 *ante*.

A view of the cable anchorage before being housed in the masonry superstructure is shown in Fig. 26. At the upper right is the cast steel sleeve and funnel, from the lower end of which are seen the sixty-one strands diverging to their respective shoes held by the first set of eye-bars. All these bars are 1¾in. by 10in. in section, with 11¾in. pins. Other eye-bars are coupled to the first set, forming anchor chains, which are attached finally to box girders, 54in. deep, 24in. wide and 40ft. 6in. long, embedded in the concrete mass of the foundation—as shown in Fig. 7 *ante*. In this way the tension on the cables creates both a pull on the eye-bars and a thrust upon the inclined steel frame and its supporting masonry.

The bold but simple and impressive architectural treatment of the anchorages is illustrated by the view of that on the Philadelphia side—Fig. 27. Two towers, carried by the circular caisson foundations already noted, form a distinctive feature, and are utilised to house lifts and stairways which provide direct communication between the bridge footwalks and the street below. Entrance halls, machinery rooms, public comfort stations and other facilities are also provided, while handsome decorative finish is given to the facilities used by the public. While the main structure is a huge mass of concrete, the exterior facing is of granite.

Loading.—Live loads on the suspension spans under extreme conditions of heavy traffic were computed as 11,990 lb. per linear foot of bridge, distributed as follows:—2000 lb. per foot of each rapid transit railway track; 1500 lb. per foot for each tramway line; 70 lb. per square foot on the roadway; and 50 lb. per square foot for each walk. In the design, therefore, the congested or emergency traffic loading, with the maximum load on roadway, tracks and walks simultaneously, was taken as 12,000 lb. per lineal foot. Half this amount—6000 lb.—was taken for normal full load, which may be reached occasionally.

Wind pressure was assumed as 30 lb. per square foot on the stiffening trusses and 50 lb. on the towers. The dead load of the completed structure is about 26,000 lb. per lineal foot in the central span and

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SUSPENSION BRIDGE OVER THE RIVER DELAWARE

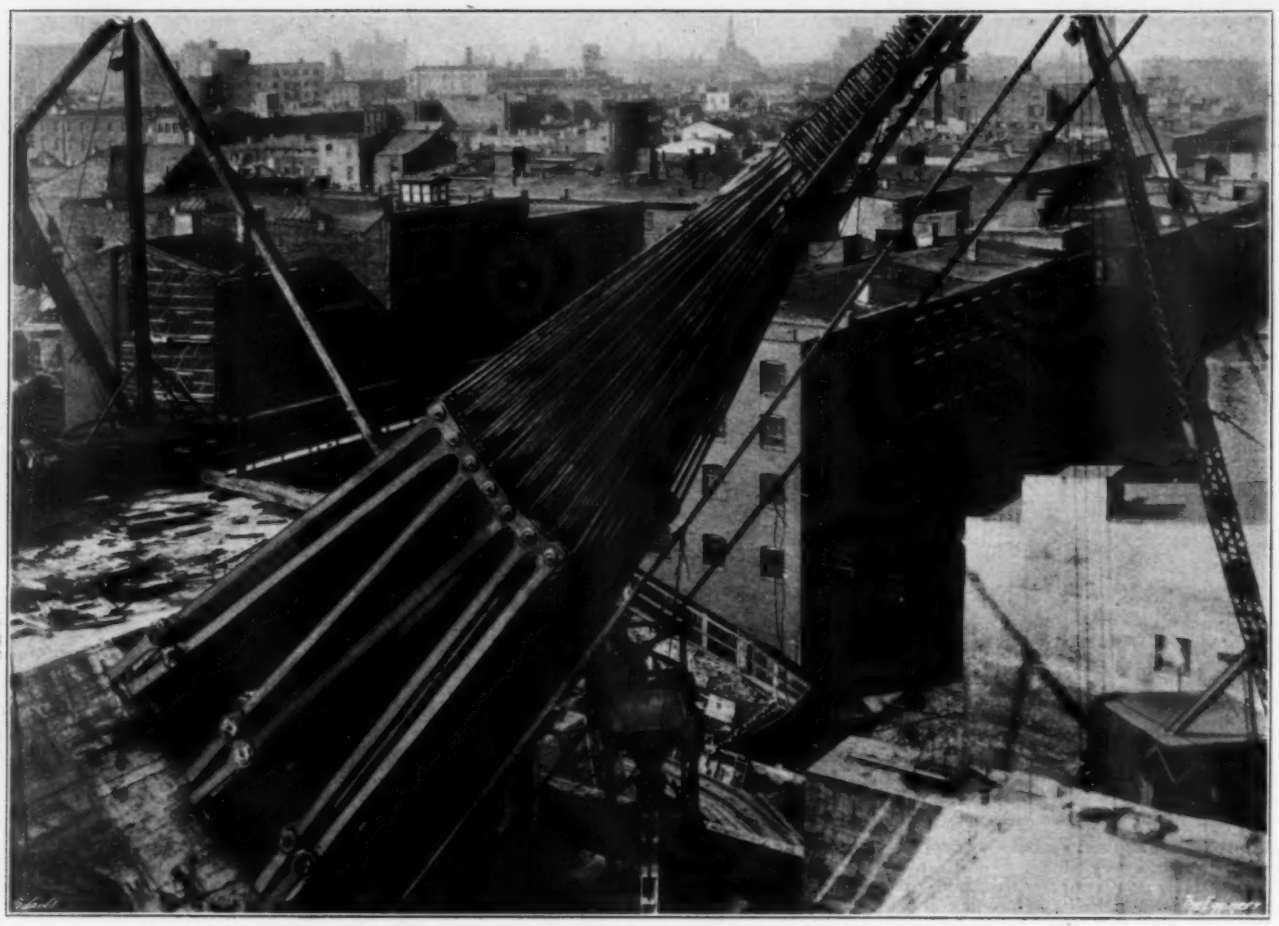


FIG. 26—CABLE ANCHOR

FIG. 27—THE PHILADELPHIA ANCHORAGE

27,000 lb. in the side spans. The maximum dead and live load at the base of each steel tower is about 35,000 tons.

Bridge Approaches.—From the street entrances to the ends of the suspension spans, the approaches consist of steel viaducts, having both truss and plate girder spans. These spans are carried by two-post steel towers on masonry piers or pedestals, 5ft. to 10ft. high. The piers are of concrete, faced with granite, and are founded on concrete piles driven in a gravel formation. In the trusses the main members are of silicon steel, and the other parts are of ordinary structural steel. Typical construction of the approaches is shown in Fig. 28, and Fig. 25 is a view of the Camden approach.

To ensure a uniform bearing of the shoes of the posts or columns upon the granite tops of the piers, rust joints were made instead of using cement grout or lead bearing plates under the shoes. For this work the shoes were seated on iron packing pieces, so as to leave a space about 1in. high between the shoe and the stone. Shields of galvanised iron were placed around this space to keep the joint material from spreading over and discolouring the stone. As the packing or joint material was placed, it was rammed thoroughly under the shoe casting by L-shaped bars, and when this was finished the edges of the joint were caulked with lead wool. Within three or four days the material had set up sufficiently to carry the full load, and the iron packing pieces were then removed.

The stonework was brushed carefully to remove all fragments of iron, and any stains were taken out by scrubbing the stone with oxalic acid. For these rust joints the mixture was composed of 200 parts—by weight—of iron borings, 2 parts of sal-ammoniac, and 1 part of flowers of sulphur, with water enough to moisten it, but not sufficient to flush to the surface when the mixture was being rammed into place.

Where the height is low and the approach runs down to the street level, reinforced concrete construction is used. At the end of the Philadelphia approach, the roadway opens into a broad semi-circular drive leading to two main streets, but there is also a street at right angles to the bridge roadway. An underground loop terminus is provided for the tramway, which will operate only a shuttle service to and fro across the bridge. This terminus, however, will be connected with an adjacent station of the Philadelphia underground railway, beneath the plaza surrounded by the semi-circular drive.

At the Camden end the roadway beyond the approach proper widens sufficiently to provide for ten traffic lanes, which are separated in pairs by six toll houses. Two additional or emergency lanes are provided outside of the outer toll houses. Beyond this toll station the roadway opens into a rectangular plaza, in which the electric tramway has a terminal loop.

Bridge Traffic.—The estimated traffic, as already noted, was 6,000,000 vehicles in 1930, and 15,000,000 to 20,000,000 per year by 1940 or 1945. The first estimate is likely to be exceeded, however. During the first two months after the opening of the bridge the daily traffic averaged 25,000 private automobiles, 1700 omnibuses and 1000 motor trucks, a total equivalent to about 10,000,000 vehicles annually. For regulation of the traffic the six traffic lanes of the 57ft. roadway are marked by lines of white paint, while the centre line of the roadway is further marked by cast steel studs set in the pavement at intervals of 100ft. Electric lamps of 1000 candle-power are arranged 120ft. apart.

All tolls are collected at the Camden end of the bridge, where the roadway at its street connection has a row of six toll houses serving the five double-lane passages which diverge from the end of the bridge roadway. Two of the toll houses are fitted with scales for checking the weight of motor trucks which use the bridge.

Bridge Tolls.—An example of the difficulties of joint work under two or more Governments is afforded by the controversy over the collection of tolls on the Delaware River Bridge. All concerned agreed that the bridge should be free eventually. As explained already, the bridge was built with funds supplied by the State of Pennsylvania, the State of New Jersey and the city of Philadelphia. On its part, the State of Pennsylvania appropriated money as needed from its current revenue. The city of Philadelphia provided money by general bond issues, the bonds to be paid for by taxation and to be redeemed in fifty years. On the other hand, the State of New Jersey raised its funds by bond issues for the bridge specifically, with the intent that tolls should pay for the interest charges and the redemption of the bonds.

On the occasion of granting an appropriation towards the expenses of the bridge in 1925, the Pennsylvania legislature also passed a Bill providing that no tolls should be charged by the State of Pennsylvania or the city of Philadelphia, the bridge to be entirely free from the time of its opening. But those members of the joint bridge commission representing the State of New Jersey held that under the terms of the bond issue of that State, tolls must be charged to cover interest and to provide a sinking fund for the redemption of the bonds. Furthermore, they held that taxes to provide for these matters would meet strong opposition, in view of the already high taxes. Thereupon, the city of Philadelphia announced that any attempt of the New Jersey officials to collect tolls at their end would be opposed vigorously. It was claimed also that as the bridge was an "interstate" structure, its traffic and operation would be subject to regulation by the United States Government.

Meanwhile, contracts for additional work which should proceed without delay could not be authorised, owing to the differences between the two sets of members of the Joint Commission. The Attorney-General of New Jersey held that the New Jersey members should not vote for the advertising of tenders or the letting of contracts, if there was any doubt of the collection of tolls. In retort and at the request of the Pennsylvania members, the Attorney-General for Pennsylvania brought suit before the United States Supreme Court to compel the New Jersey members to co-operate with the others in letting contracts, in order to ensure the progress and completion of the work, leaving the tolls controversy to be settled separately.

Before the date set for trial of the case, however, there were changes of city administration at Philadelphia, while the Pennsylvania legislature experienced a change of heart, partly due to a better understanding of the reasons for the New Jersey position, and owing also to the rather welcome possibility of recouping the State for part of its money expended on the construction of the bridge.

As a result, the Bill prohibiting tolls was repealed, and the members of the Joint Commission returned to their former amicable relations. By speeding up the procedure for the letting of contracts and also for carrying on the work, the engineers made it possible to complete the bridge within the expected time, in spite of this vexatious delay. The bridge was opened officially to traffic on July 1st, 1926. The present rate of toll is approximately 1s. for each vehicle, an amount which is expected to return the entire cost of the bridge by 1940.

Cost of the Bridge.—For this great suspension bridge the total estimate of cost was £5,776,000, including £1,280,000 for land or property required. This sum was to be provided as follows:—State of New Jersey, £2,486,000; State of Pennsylvania, £1,645,000; city of Philadelphia, £1,645,000. The £4,496,000 for construction included £2,671,000 for the bridge proper; £1,293,700 for the approaches and for incidental street and sewer changes; and £531,300 for engineering administration and contingencies. Radical changes in conditions, in prices of materials, and particularly in property values, increased the actual total cost to about £7,200,000. From figures given in Mr. Carswell's pamphlet on the building of the Delaware River Bridge, this actual cost was divided about as follows:—

	£
Suspension bridge	3,096,000
Philadelphia approach	832,200
Camden approach	680,800
Toll houses	4,500
Total for contract work	4,613,500
Engineering expenses	301,300
Total construction cost	4,914,800
Land and property	2,289,870
Grand total	£7,204,670

Other Large Suspension Bridges.—Of the three suspension bridges over the East River at New York City, shown in Fig. 5, the Brooklyn Bridge, opened in 1883, has a main span of 1595½ft. and two shore spans of 930ft. Its four 15¾in. cables, each composed of 5358 parallel wires, are carried by massive towers of stone masonry, which are of good architectural design and add greatly to the dignity and the general appearance of the bridge. In all the other suspension bridges mentioned, all of which are of later date than the Brooklyn Bridge, the towers are single gallows-frame steel structures, so that they are somewhat less significant in appearance and in relation to the spans, while the dignity of the masonry towers is lacking.

The Williamsburgh Bridge, opened in 1903, with a 1600ft. main span, is peculiar in having no suspenders on the shore ends of the cables, 596½ft. long, the approaches consisting of steel viaducts which extend to the towers of the river span. It has four cables,

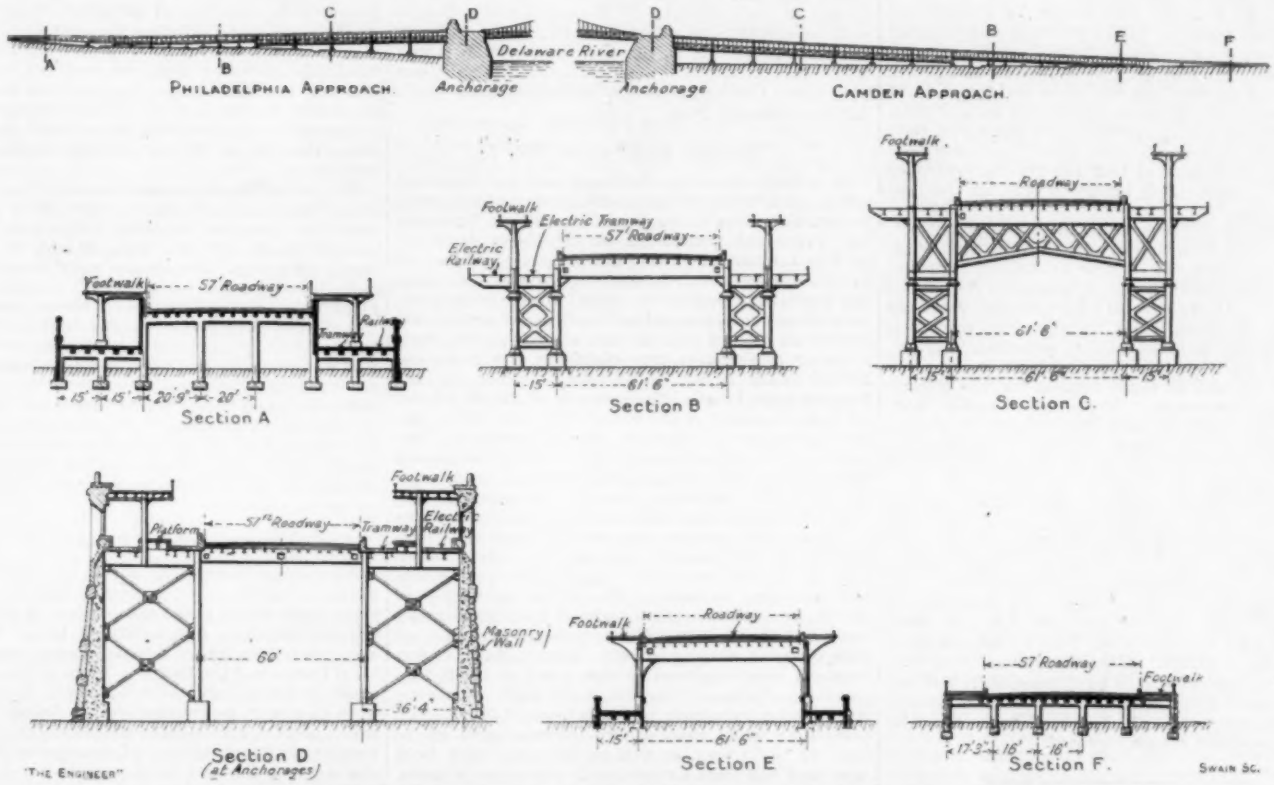


FIG. 28—TYPICAL CROSS SECTIONS OF THE APPROACHES TO THE DELAWARE RIVER BRIDGE

18⅞in. in diameter, each composed of 7696 wires. The Manhattan Bridge, opened in 1909, has a river span of 1470ft., and side spans of 725ft., carried by four cables, 21⅛in. in diameter, each composed of 9472 wires. The Queensboro Bridge, further up the river, has two cantilever spans of 1280ft. and 984ft. length over channels separated by an island. In addition to highway vehicles, all of these bridges carry electric tramway and rapid transit or local railway lines, the latter connecting with the elevated and underground railways. The Bear Mountain suspension bridge over the Hudson River, above New York, opened in 1924, has a span of 1632ft., but is for highway traffic only, and is designed to carry loaded motor trucks of 15 and 20 tons weight. It has steel towers, 350ft. high, supporting two cables, 18¾in. in diameter, each having 7252 wires. Owing to the mountain slopes on either side, the shore spans are so short that it was more suitable to carry them on piers than by suspenders from the cables. The cables are spaced 55ft. apart between centres, so that the 38ft. roadway and two 5ft. footpaths are all between the stiffening trusses.

A suspension bridge proposed to span the Detroit River and connect the cities of Detroit, U.S.A., and Windsor, Canada, as well as to connect the railway lines on either side, would, have a channel span of 1800ft., and the shore ends of the cables would be 925ft. long to the anchorages. But these shore ends would have no suspenders, so that the railways would have rigid viaduct approaches, and only the river span would be flexible. This bridge, as designed for heavy railway traffic as well as tramway and highway vehicles, would be a double-decked structure, with eight cables, 18in. and 21in. in diameter, arranged in two tiers of four each, for the upper and lower decks respectively. On the upper deck is to be a double-line of tramway separating two 28ft. roadways, each with a 7ft. footway on the outer side. The lower deck would have four lines of rails for general passenger and goods traffic. This bridge is only in the promotional stage.

The most stupendous suspension bridge project, however, is that for a highway bridge over the Hudson River at the north end of New York City, requiring a span of about 3600ft., and estimated to cost about £10,000,000. At present, all passenger and vehicular crossing of the river, which aggregates an enormous daily traffic and includes a heavy suburban business, is handled by numerous lines of large steam ferry boats and by two or three tunnels for the electric underground railways. Plans now under consideration by the Port Authority provide for a main floor or deck wide enough for four lines of passenger automobiles, and a lower deck for tramcars and motor omnibuses.

This 3600ft. Hudson River span is not the longest proposed, however, as designs have been made for a suspension bridge with a span of 4850ft. across the harbour entrance at San Francisco. Eight cables, 18in. in diameter, arranged in pairs above four lines of stiffening trusses, would pass over steel towers about 880ft. high and be anchored into the solid rock of the hills on either side. This would give shore spans of about 2425ft. Whether such an enormous span will be undertaken is problematical; but the 3600ft. Hudson River bridge for New York is already in the preliminary stages of design, while the financial arrangements have been completed.

The Steel Industry in South Africa.

(*By our Special Correspondent in South Africa.*)

A development in the industrial activities of the Union of South Africa was foreshadowed in a paragraph contained in the Governor-General's speech at the opening of the Union Parliament on January 28th, which is of the very gravest importance to all British manufacturers of plant and machinery, and indeed every variety of metallic products, who are supplying, or desire to supply, South Africa with its requirements. The paragraph reads: "The question of the development of the Union's great natural resources of iron ores and the establishment of an iron and steel industry which will make South Africa self-dependent in this essential commodity, has engaged the attention of my Government. The history of the efforts made in the past in this direction has convinced my Ministers that direct Government assistance and participation are necessary to ensure the establishment of steel works on an adequate scale. A Bill embodying my Ministers' proposals will be introduced in due course."

In order to make the position clear, it is necessary to explain that there are at present in the Union three companies formed for the purpose of manufacturing iron and steel.

The Pretoria Ironworks, now the South African Iron and Steel Corporation, Ltd., was established in 1918, and a small blast-furnace was erected for the purpose of testing the suitability of the iron ore deposits upon the Pretoria town lands, and in the near vicinity. After a total production of 2000 tons, the furnace was blown out and a foundry erected to work the product. The quality was found to be suitable, and attempts were then made to obtain capital for the development of the concern into a modern plant of considerable size, capable of supplying a large proportion of the requirements of the Union for iron and steel goods, such as rails, sections, fencing material, &c. This capital has not been obtained, although experts have reported that the quantity and quality of the ore is satisfactory, and coal and other suitable raw material, also water, are close at hand. Mr. Delfos, the managing director, has from time to time announced the imminent success of his endeavours, especially with German, Dutch and Belgian steel producers, but always there has been eventual failure.

On the strength of optimistic representations, an agreement was entered into by the Government of the Union and the company in 1920, that the railways and harbours should purchase certain of their requirements of iron and steel goods, and that the company should have the right of purchasing Government scrap at a favourable price. The company was to deliver a consignment of experimental rails for 5 miles of track from January 1st, 1923, to January 1st, 1928, and there was a penalty clause of £5000 for non-fulfilment of the contract. In May, 1925, the company not having been able to do anything, asked to be released from the penalty, and this was granted.

The Dunswart Iron and Steel Company, Ltd., was started in a small way in October, 1918. It has a compact plant at Dunswart, and has a capacity of under 1000 tons per month. It has a rolling mill which can turn out small section rails and a large variety of work required by the mines and railways, and, in addition to other furnaces, has a Héroult electric furnace. It is, however, entirely dependent upon scrap iron, which it purchases, although it can now, since the latter part of 1926, purchase South African made pig iron.

Biggest Steel Producer.

It is only, however, the third and last company which can be regarded as a really important industrial undertaking—the Union Steel Corporation, Vereeniging, Transvaal—which has already been described in The Engineer. This plant began operations in 1913, depending entirely on scrap iron and steel for raw material. During the period of its active existence of twelve years, it has handled and turned out more than 200,000 tons of steel, and has proved itself a factor of first-rate importance in the industrial life of South Africa. The plant consists of four Siemens open-hearth basic furnaces of 15, 20, 25 and 30 tons capacity respectively, with the usual gas producers and two Héroult electric furnaces. The rolling mills consist of one 12in., one 15in. merchant bar mill, and 22in. cogging and finishing mills, with the necessary reheating furnace, mechanical live roller conveyors, hot banks, loading banks, modern hot saws and straightening machines and roll turning lathes. The foundry is equipped for the production of both iron and steel castings with drying stoves and annealing furnaces. The works buildings are served by three electric overhead travelling cranes and extensive sidings. The products cover a very wide range of sections, rounds, squares, flats, angles, channels, weighing from ·375 lb. per foot to 30·6 lb. per foot. Tube mill bars in hard steel are manufactured for the mines, and rails from 16 lb. to 45 lb. per yard. Steel castings are manufactured up to from 10 to 15 tons, as well as shoes and dies, both cast steel and forged steel, for use in mine batteries, &c. &c. In 1925 the Corporation purchased the works of the Newcastle Ironworks, Newcastle, Natal, which consisted of a modern blast-furnace not quite completed. This furnace was to a great extent rebuilt and it was blown in at the end of the first half of 1926. It has a production of 1000 to 1200 tons per week. The pig iron produced is stated to be of excellent quality, many foundries and engineering works declaring it to be equal to the best imported, and costing them considerably less. Last year the production of the Union Steel Works was nearly 40,000 tons of steel, &c. For the purpose of extending its activities and using the whole of the pig iron produced, the company has just entered into a kind of partnership with Stewarts and Lloyds (England), and a third company, formed by these two, is proceeding to erect a works to turn out all the pipes and tubes which the Union requires. In addition, by the end of March, a wire works with a capacity of 20,000 tons yearly was to start operations. There has also been in operation, since early last year, a nut and bolt works. The Corporation possesses deposits of iron ore to the amount of 50,000,000 tons, said to be of the best quality, much of it going 60 per cent. metallic iron, within a few miles of its steel works, and still larger deposits could be obtained if required from only a little further away. It has its own coal mines right at its door, and from them 1,798,000 tons were sold in 1925, and probably considerably more last year. Finally, the Corporation has practically adjoining its steel works, a brick and tile works, where all the bricks, including fire-bricks, for the steel works, &c., are obtained, the rest of the output being readily disposed of.

Careful independent calculations by the experts of the railways, mines and other industries, closely agree that the total of iron and steel imports annually amount to 300,000 tons, but obviously a large part of this total relates to manufactured articles produced by specialised industries, which could not be attempted in the Union as an economic proposition. It is, however, estimated that 165,000 tons of the country's requirements could be produced within it. Taking the augmented production of the Union Steel Corporation and its subsidiary works, also the Dunswart output, quite 120,000 tons of that will be produced annually from about the middle of this year. There, therefore, seems no necessity for the Government to proceed with a State-aided scheme in which it would have a controlling interest.

First of all, the present Government and its supporters in Parliament and the country are composed of the Dutch portion of the population, who want a republic, and of the Labour Party, whose aims are socialistic and anti-capitalist. The Mayor of Pretoria, Mr. Claudius De Vries, stated, immediately after the Governor-General's speech, that his mouth was no longer closed, and proceeded to say that he had discussed the matter with the Government. Pretoria had many advantages to offer, it would charge only 2d. a ton for the ore on its lands, and would give water at cost price, and it had the cheapest water in the Union. It would make no charge for the land on which the industry was established, and it would impose no taxes on the improvements of the company. Mr. Delfos, chairman of the South African Iron and Steel Corporation, had failed to secure the needed capital in Europe, and it seemed that it was against the interests of the ironmasters of Europe to have such an industry established. The Mayor further said he did not know where the capital would come from, whether Government would find it or it would come from overseas, but the Government was going to push the business through. A company would be formed to take over the assets of the South African Iron and Steel Corporation, with a capital of about £4,000,000. To all this may be added that Mr. de Vries is interested in this Corporation.

The Government, through its chief Press organ, has stated that although continuous efforts have been made for a number of years, it has been found impossible to get sufficient financial support, and so it has to intervene. How it can say this in face of the facts, one cannot understand. A sum of over 1½ millions sterling has already been invested in the Union Steel Corporation's works, and nearly another million is being expended in extensions to the works, and the new wire and pipe and tube works. As to the difficulty of obtaining money, it is on record—being evidence given before the Select Committee on Railways and Harbours on May 15th, 1925—that the Union Steel Corporation the previous month—April—asked the London market for £300,000 in debentures, and had nearly 6,000,000 applications in seventeen minutes!

Government's "Partners."

As to the direction in which the Government is likely to turn for its "partners" in this steel enterprise, past events make the putting of two and two together anything but a difficult task. Some years ago, when the South African Party, consisting of loyal Dutch and the British portion of the population which is not Socialist and is devoted to the Empire were in power, representatives of Armstrong, Whitworth and Co. investigated the possibilities of a steel industry in South Africa. However, the Government did not feel disposed to co-operate beyond granting a bounty on production, and as it is in the development stage and in the establishment of the works before the production stage is reached that the financial resources of a company are strained, this came to nothing. Hardly, however, were the Nationalists in power than there arrived in the country Drs. Kipper, Hilge, Phillippi, and Reusch, steel experts, who conducted lengthy researches and experiments. These representatives of German, Dutch and Belgian steel producers had a very favourable reception from the Government, and it leaked out—The Engineer at the time published some information it received—that not only was the Government prepared to offer liberal encouragement, financially, to the venture, even to the extent of guaranteeing the interest on the debentures for a fixed period, but to guarantee also to place all Government business with the concern and to protect the industry, either in the form of a bounty on production or through the Customs, whichever might prove the most practical. It was then announced, as the result of research, that Pretoria townlands had 24,000,000 tons of high-class ore, and that several times as much was available near by, the Witbank coalfield was close at hand, and so also was Germinston, which is the biggest centre of distribution in the Union. All these points, which are not disputed, were put forward in support of the Government's proposed action. But the news caused a great outcry from the British people in the Union, and so, very quickly, there was a semi-official denial, but it was also stated that "there may have been conversations on this important subject between the Department of Mines and Industries and some people across the water, for the Government, of course, is profoundly interested in the development of the iron and steel industries. But at the moment there is nothing concrete for the Government to negotiate upon."

Whether the Government will succeed in its object

depends upon the nature of the opposition which the British section of the population of the Union offers to this further move in the policy of gradually weakening the connection with the Empire. What is thought of the Government's intentions by the English Press in the Union can be gathered from the following extract from the *Star* (Johannesburg): "It is difficult to see reason for such a step apart from the well-known predilection of certain Ministers for State interference in all industry, and their accompanying dislike for every kind of private enterprise. If a Government steel industry is launched and maintained at the cost of the State, losses incurred will be met out of taxation, and whether the industry is successful or not, its competition must be a severe blow to the already established industry, and to those engaged therein, both as investors and workers."

Scientific and Industrial Research.

THE report of the Committee of the Privy Council for Scientific and Industrial Research for the year 1925–26 was issued at the end of last week. It may be obtained from H.M. Stationery Office, price 3s. net. As usual the Committee's report, signed by Lord Balfour, is followed by a report made to the Committee by its Advisory Council, a body composed of twelve eminent scientists, presided over by Sir William McCormick. We give below the principal portions of the Committee's report.

ESTIMATES.

During the year under review we received recommendations from our Advisory Council on the programme of research for 1926–27 for which, and for administrative services, we have drawn net estimates amounting to £442,877, as compared with £380,263 for 1925-26 and £328,281 for 1924-25.

POLICY.

The report of the Advisory Council summarises the principal conclusions it has reached during the past year as the result of an intensive study of the present position of purely scientific and of industrial research in this country, of the effects produced by the work of the Department during the last ten years, and of the principles that its long experience has led it to believe should guide the Government in assisting industry in the coming years to move over from the empirical methods of the past to those of scientific direction and control.

It finds no grounds for anxiety in the field of pure science, though the recent drift of scientific theory and other causes have led to the comparative neglect of certain spheres of inquiry which happen to be important at the moment for the development of industry. The shortage of investigators is particularly evident in the biological sciences, upon which the progress of agriculture and its allied industries throughout the Empire so intimately depends.

The Advisory Council points out that in the field of applied research the duty of the Department is rather to stimulate than to replace private enterprise, save in certain directions where the needs of Government itself or the direct interests of large sections of the community justify the expenditure of public funds on a large scale over long periods for the solution of industrial problems. Outstanding examples are the study of our fuel resources and of the preservation and transport of food-stuffs. We concur in this view, and we share with regret the fears that in many cases industry has not in the past taken systematic steps to explore with the help of research the possible applications of new discoveries in pure science likely to lead to entirely new products or processes, though there is considerable evidence of a growing attention to the improvement of existing processes. We have in mind not so much the circumstances of the last critical year as the whole ten years' period reviewed by the Advisory Council. A practical rather than a theoretical objective is always the aim of industrial research, and unless research has that aim—directly or at a remove—it does not fall within the functions of the Department of Science and Industrial Research, or, indeed, within those of industry itself. But industry is undoubtedly concerned with pure research as much as it is with applied—for not only does it watch the output of university laboratories, seeking to find practical applications for the discoveries of the man of science who has worked with no utilitarian aim, but its own investigations in applied science reveal gaps in scientific theory which hold up advance in practice until they are filled. To fill these *lacunæ* in knowledge is at least as practical as to find applications for the results of the worker in pure science. Thus the research with which we are concerned is practical in aim, whether it be pure or applied research, and it shows this intention throughout. The choice among the multitudinous lines of advance is determined by the practical consideration of where the material advantage is most likely to lie. Between two problems both offering the same probability of solution, if success in one will produce a big saving or profit and in the other a relatively small improvement, there should be no difficulty in choosing. The difficulty often lies in estimating the relative importance of the alternative problems in the cost of production. This difficulty can only be removed by an economic study of the industry from the research standpoint. We are not sure that inquiries of this kind have been sufficiently prosecuted in the past by industrial research workers.

When the choice has been made, a practical aim similarly informs the actual investigations. Interesting but irrelevant inquiries must either be put aside for study by the research worker in pure science, or be reserved until it can be seen that they may be endowed with a practical aim by the progress of work proper to the purpose in hand. And when results have been obtained in the laboratory or on small scale plant, the practical aim takes the form of promoting their utilisation in industrial production—often the longest and most costly part of the long series of experiments which began with an idea or a theory in the mind of a scientific man and ends at last in the foundation of a new industry or the revolution of an old process. We think there is some evidence that British industry has not hitherto always paid sufficient attention to the need for the same accuracy of scientific control and the same spirit of research in these last stages as are expected in the laboratory.

The report of the Advisory Council shows, we think, that there is still much to be done before our industrial position is re-established, but it records with no less emphasis how much has already been achieved. To look back over the last ten years is full of encouragement for the future, if the efforts already made can be continued and increased.

RESEARCH ASSOCIATIONS.

New research associations are still being formed. During the year a research association for the preserved food industry has been definitely established and has made arrangements for the closest co-operation with the Research Association for the cocoa, chocolate, sugar confectionery and jam trades. More recently a research association for the paint, colour and varnish trades has been constituted and will shortly commence operations. Grant aid will be given in both these cases.

During the year we have given consideration to three further reports upon the work of the British Motor Cycle and Cycle Car Research Association, the British Silk Research Association and the British Cast Iron Research Association. As in the case of other associations which have reached the end of their initial five-year grant periods, the reports have been framed with the assistance of independent scientific experts who have reviewed the operations of each Association since its formation. With these inspections the survey of the early work of research associations has nearly been completed; the next to fall due will be that of the Research Association of British Flour Millers in about two years' time.

The report upon the British Motor Cycle and Cycle Car Research Association indicated that work useful to the manufacturers had been accomplished, and that there was a prospect of the organisation becoming gradually self-supporting. In consequence we have authorised block grants annually diminishing for a further period of five years, so that with an increasing income from subscriptions an expenditure of at least £2000 a year may be incurred.

The British Silk Research Association was considered by the inspectors to have embarked upon a satisfactory programme of work, and to have enlisted the confidence of a considerable section of the industry by its operations. Accordingly, we have agreed to give diminishing block grants for a further period of five years to secure an annual expenditure of at least £3500.

The case of the iron-founding industry, as represented by the British Cast Iron Research Association, displayed certain special features. This trade includes a great number of very small foundries scattered throughout the country, and is technically backward; but the Association has done a good deal of useful work and has carried conviction to its members. Accordingly, we have made an offer to the industry of £ for £ grants between prescribed limits for a period of three years and grants at the rate of 10s. per £ for a further two years. We have also advised the Association to strengthen the scientific staff by the addition of a scientific investigator of standing in metallurgy.

In the case of the Research Association of British Rubber and Tyre Manufacturers it was clear that the recommendations of the inspecting committee regarding the scale of expenditure could not be put into effect without recourse to the accumulated funds of the Association. After obtaining the considered views of the Association, we have decided to give diminishing block grants ranging from £2000 to £400; at the same time, the industry will need to find a subscription income increasing from £2000 to £5100 in the fifth year of the second period. In order to secure an annual expenditure of £7000, withdrawals from the reserve fund amounting to £13,000 over the five years will be necessary.

We were much impressed by the favourable nature of the report upon the British Leather Manufacturers' Research Association, and, as stated last year, we hope to see this organisation become self-supporting with assistance from the Department upon a diminishing block grant basis. As an interim measure we have authorised the continuance of grants of £ for £ between suitable limits for a period of two years.

When the position of the Scottish Shale Oil Scientific and Industrial Research Association was discussed in last year's report it was noted that the views of the independent experts were being considered by the Association. These views were, briefly, that the past operations of the Association had been too limited in extent and that the circumstances of the industry called for the vigorous prosecution of research on a considerable scale, involving a material increase of expenditure. The Association is not in agreement with these views, and considers them impracticable. After seeking further advice from the scientific members of the inspecting committee we could not see our way to give further aid for the assistance of the restricted programme of work proposed by the Association; more especially as the funds in hand would enable work to be continued upon the present limited scale without any increase in the rate of subscription made by the few firms which comprise this industry.

The Research Association of British Motor and Allied Manufacturers, and the character of the research work which the industry it represents should undertake, were discussed last year. It was represented to us that the Association would be greatly strengthened in its appeal to the industry as a whole if grants on the diminishing block system were made, as had been done in other cases, and if the programme of research could, for the present, continue unchanged. We have acceded to this proposal, and we trust that the Association will be successful in its appeal to the industry for a full measure of support.

The activities of the British Cutlery Research Association have necessarily been more in the direction of invention than of research, and the machines in course of development showed considerable promise. Grant assistance will be given to this Association for a further five-year period on the following basis:—A grant of £1000 a year will be made provided a sum of at least that amount is subscribed annually by the firms in the Association, which is now more fully representative of the industry. Moreover, advances at the rate of £2000 a year will be made during the period to enable the Association to carry out work on the perfection of machinery for the production of cutlery; these advances will be repayable to the Department from royalties in respect of the machines so devised.

The existing arrangement with the British Refractories Research Association of grant on the original basis of £ for £ is being continued for another year.

We had hoped to be in a position to state that the British Empire Sugar Research Association had been established on a normal footing by this time, but we regret to say that, despite much admirable research work accomplished by the special committee, in aid of which grants have been made on the recommendation of the Advisory Council for the past four calendar years the appeal to the industry for the necessary contributions was unsuccessful. This unfortunate result is undoubtedly due in the main to the depressed state of the industry, but in all the circumstances we have not felt justified in authorising any further grant assistance being given.

For the financial year 1925–26 grants to associations amounted to £88,216, and the balance of the Million Fund remaining unexpended on March 31st, 1926, amounted to £429,984. It must be realised, however, that there are important charges to be met from the balance of the Fund which arise from promises of further grant aid to associations, either in their initial stages or in periods subsequent to their first quinquennia.

The financial position of the Fund has recently been reviewed, and the survey indicates that at March 31st, 1926, the uncommitted balance of the Fund amounted to £144,647.

FUEL RESEARCH.

The work on fuel research has been greatly affected during the year by the difficulties in the coal industry. The Royal Commission on the Coal Industry (1925) was appointed in September, 1925, and Dr. C. H. Lander, the Director of Fuel Research, was appointed as one of the Assessors to the Commission. The Report of the Commission issued in March, 1926, contains a number of recommendations and suggestions bearing on the work of the Department. It emphasises the importance of the investigations being carried out under the Director of Fuel Research, and urges the necessity of the extension of work into the winning of coal and cognate problems not at present undertaken by the Department.

Research into matters connected with coal falls naturally into three groups: (i.) problems connected with the winning of coal and its preparation for the market; (ii.) problems of safety in mines; and (iii.) problems of utilisation. Each of these groups presents an important range of problems, and though in some respects they are distinct, they all require information as to the actual types of coal available and the characteristics of each type. There are other subjects of research which concern two or more of the groups, notably those of cleaning and grading coal and methods of sampling and analysis, which are already dealt

with to some extent by the Department, and are of great importance to users as well as producers of coal.

The question how far the State should assume responsibility for directing or assisting the necessary work has been the subject of much consideration.

The investigation of the main problems connected with coal winning is, and must be, primarily the concern of those responsible for the actual mining industry. This is one of the cases which the Government scheme of industrial research associations inaugurated ten years ago was designed to meet, and for which the scheme appears satisfactory. But the capital sum of £1,000,000 voted for this purpose in 1916 has been largely expended or allocated, and the balance remaining is insufficient for assistance to the Colliery Owners' Research Association on the scale contemplated by the Royal Commission, although we agree that an annual expenditure of the order recommended by the Commission will be necessary if the work is to be carried out adequately.

The work on safety in mines is already being carried out by the Safety in Mines Research Board, and is financed by the Miners' Welfare Fund.

The general work on utilisation and the physical and chemical survey of the national coal resources is undertaken by the Department, and is proceeding as rapidly as circumstances allow. The expansion of the survey of the coal seams has been retarded by the difficulties in the mining industry, but now that work has been resumed progress will be facilitated by the provisions of the Mining Industry Act (1926), giving officers of the Department right of access to workings and the right to obtain specimens of the coal seams and other minerals opened out or worked.

As regards the chapter of the Report of the Royal Commission dealing with utilisation, we wish to draw special attention to the remarks on the present position of low-temperature carbonisation of coal. The question of Government aid for the development of methods for the low-temperature carbonisation of coal has again been under consideration. Our view is that the proper duties of the Department are to obtain general technical data on the subject and to place them and the experience of the Department at the disposal of all serious workers on the problems involved. The question of the assistance that can be given to the development of privately owned plants is a difficult one. Before a system can come into successful use on a large scale there are certain definite stages that must be passed through. The idea is first proved on a small scale, and then on an intermediate scale so that data may be obtained for the design of a full-sized unit. The unit plant is then worked and studied to form as close an idea as possible of how a commercial plant is likely to work, both from a technical and commercial point of view. It is, however, only after a plant of considerable size, embodying probably many "unit" plants, has been in operation under commercial conditions for a period of years that its success can be said to be proved. There are several systems that have reached the stage of the erection of a "unit" plant or something closely approximating theretc, and, in accordance with the offer made by the Government two years ago, the Department has already carried out tests on the technical performance of five of these plants, and has published reports on four out of five of the tests. These reports express no opinion on the future commercial possibility of the plant tested, as success can only be proved by long continued steady working. We consider that assistance in the commercial development, *i.e.*, in the final stage mentioned above, is not in any case one for the Department.

We fully concur with the view of the Royal Commission on the Coal Industry as to the desirability of a survey of the heat, light, and power requirements of the country. General efficiency has undoubtedly suffered in the past from a lack of co-operation between the various industries supplying heat, light and power, or between industries using large quantities of heat and those requiring power. It is impossible to say, with all the information at present available, what economies are really feasible, but they should be considerable. Accordingly we desire to record our satisfaction at the establishment of the National Fuel and Power Committee, and we entertain the hope that the deliberations of this body will produce results of lasting benefit.

Food Investigation.

The establishment of the Empire Marketing Board by the Government, with a fund of £500,000 for the present financial year and an income of a million in subsequent years, cannot fail to influence the work of the Food Investigation Board and the research into the preservation and transport of foodstuffs which the Department has carried on since 1917. The research carried on at the Low-temperature Station, Cambridge, and elsewhere must greatly assist the effective marketing of food products, whether grown here or in the Empire overseas, and close co-operation with the Empire Marketing Board and with our sister research organisations in the Dominions and Colonies will enable quicker progress to be made in the solution of the many problems unsolved. Accordingly, we forwarded to the Empire Marketing Board a comprehensive report, prepared by our Advisory Council, in May last, recommending an extension of the Low-temperature Research Station at Cambridge, the erection of an experimental fruit store of commercial size at East Malling, the establishment of a fish research station at a suitable seaport, and a corresponding development of the staff and work at an estimated average cost of about £50,000 a year for capital and maintenance over the next five years. The report was accompanied by a request to the Empire Marketing Board for the necessary funds as a grant-in-aid. The Board promised to meet the capital cost up to £25,000, of an extension of the Low-temperature Research Station, and to provide, as a grant-in-aid £5000 a year for five years, beginning in the year 1926–27, to enable the researches in progress at the station to be extended. The Board has promised sympathetically to consider a request for an increase in the amount of this grant should need for additional funds arise, and has under consideration the possibility of providing further sums in support of the other branches of the work referred to in the Advisory Council's report.

Forest Products Research.

The work of the Forest Products Research Laboratory is still mainly being carried out in temporary quarters at the Royal Aircraft Establishment, South Farnborough. Designs and estimates for the new buildings at Princes Risborough have been prepared by the Office of Works, and sanctioned by the Treasury, and the buildings are now in course of erection; it is expected that the transfer from Farnborough will take place about the middle of 1927.

Building Research.

As was anticipated, the private house at Garston, near Watford, purchased in 1925, for the accommodation of the Building Research Station, has lent itself excellently to adaptation into laboratories and offices. The main alterations to the building were completed by December, 1925, and the majority of the staff were transferred to Watford at that time. The station is now in a position to cope with the important additional work in relation to housing difficulties and other immediate problems of the building industry. That the services which the station is able to render to the industry are actually needed has been proved by the steady growth of the number of requests for special investigations. As an instance may be mentioned the request from the trade association representing the firms engaged in the terra-cotta industry in the country for co-operative action in a scheme for the conduct of investigations on the weathering of terra-cotta. The Association has agreed to make contribution on a £ for £ basis of the order of £1500 in all, over a period of two years, towards the cost of investigations at the Building Research Station, primarily directed to the evolution of satisfactory quick-ageing tests.

Severn Barrage Inquiry.

Reference was made in our last annual report to the work of the Committee appointed by the Department to report on the possibility of building a barrage across the Severn.

The Committee has presented a report, the conclusions of which were sufficiently favourable to make it clear that it was desirable that the inquiry should be extended. As the extension of the inquiry involves the consideration of many problems other than those which are purely technical in nature, the Lord President decided to transfer its supervision to a sub-committee of the Committee of Civil Research. Members of the original Departmental Committee are members of the new sub-committee, which also contains representatives of interested Government Departments.

Chemical Research Laboratory.

The first section of the Chemical Research Laboratory was completed during the current year, and is now occupied by staff previously engaged at other centres or newly appointed. The space at present available is insufficient and unsuitable for the research work on the corrosion of metals to be transferred to the laboratory, but we hope that it will be possible to accommodate the staff employed on this work when the approved extension to the existing building is ready for occupation.

Patents.

During the year five applications for British patents, in addition to corresponding foreign and colonial applications in some cases, have been filed by the Department, and ten British and foreign patents have been abandoned or allowed to lapse. The subject matter of the applications relates to radio telegraphic direction finders, cathode ray repeaters, synthetic resins, substitutes for dental rubber, and means for applying plaster to walls.

The Department has disposed of its rights in a patented process for the manufacture of glue and gelatin from fish skins on favourable terms, and has also agreed to sell the radio telegraphic direction finder patents. Further licences have been granted in connection with the patents covering the colouring of aluminium and its protection from corrosion. A limited licence has been granted in connection with the cathode ray oscillograph.

British Coal in France.

The annual report presented to the Comité Central des Houillères de France gives special prominence to the policy which French coalowners are pursuing with a view of restricting the importation of foreign coal. The strike of British miners last year so entirely changed the conditions of the continental colliery industry that coalowners find it necessary to secure protection in order to dispose of an increased production in their own markets. When supplies of British coal were stopped, the continental coalowners had to take measures to increase the output as much as possible, with the result that the coal production on the Continent during 1925 was 30,000,000 tons more than in the preceding year, which is exactly the amount by which the British coal exports declined during the same period. In Germany the increase was 12,500,000 tons, in Poland 6,500,000, in France 4,500,000 tons, in Belgium 2,250,000 tons, in Holland 2,000,000 tons, in Czecho-Slovakia 1,750,000 tons, and in the Saar 700,000 tons. The French production of coal reached the record total of 52,477,522 tons, which represented 66 per cent. of the total home consumption. Now that British coal is again invading the continental markets, the French coalowners are looking to the future with some apprehension. Situated mostly in the extreme north of France, the collieries are placed at a great disadvantage for the distribution of coal in the western and southern parts of the country, where the British are able to profit from lower sea freights to undersell the native coal. Efforts are being made to meet this competition by bringing down prices, which is only possible by a reduction in miners' wages, and it is very doubtful whether prices can be lowered sufficiently to check the importation of British coal on the western seaboard. Unless this is done French coalowners fear that they will lose the advantage of the great development work they have been carrying out, especially as the report admits that the individual production of French miners is below that of the British. It affirms that unless something is done to protect the home colliery industry, there is a fear of a heavy accumulation of stocks which will place coalowners in a very unfavourable position. Many of them are certainly already feeling the pinch, and hardly know how they will pass through the summer months. It is quite possible that the Comité Central des Houillères de France is presenting the future in sombre colours as a means of impressing upon the Government the necessity of protecting the industry under the new Tariff Bill. As compensation it offers a plan whereby it hopes to reduce the importation of coal into France from 20,000,000 tons to 12,000,000 tons yearly within a period of seven years, this being accomplished by a larger output, a better use of the poorer qualities of coal, and a general economy in coal consumption. In pursuance of that plan, the coalowners hope that their newly formed company, known as Carburants et Produits de Synthèse, will develop methods for the chemical treatment of coal and its by-products, and will also produce a fuel which will supersede anthracite. The Comité des Houillères de France urges that, if it is to carry out this programme, there must be an import duty on anthracite, and the distribution of French coal must be facilitated by specially reduced railway rates to the ports on the western seaboard, where coalowners may dispose of a surplus production in competition with British coal.

The German Steel Combination.

The great combination of German colliery and iron and steel undertakings, which was first brought into existence on April 1st, 1926, after negotiations extending over several months, has now issued its initial report dealing with the six months ended with September 30th, 1926, which constitute the first financial year. As may perhaps be remembered, the combination, which has the title of the Vereinigte Stahlwerke A.G., and has an ordinary share capital of £40,000,000, represents an amalgamation of almost all the properties formerly possessed by the following concerns:—(1) The Rhine-Elbe Union, with the Deutsch-Luxemburgische Bergwerks und Hutten, the Gelsenkirchener Bergwerks A.G., and the Bochumer Verein für Bergbau und Guss-stahlfabrikation; (2) the Phœnix A.G. für Bergbau und Huttenbetrieb, and the Ver. Stahlwerke van der Zypen und Wissener Eisenhutten; (3) the Rheinische Stahlwerke; and (4) the Thyssen concern. The undertakings of these companies were taken over on the formation of the combination, and since then various additional works and plants have also been acquired.

The report states that the concerns participating in the combination are more than ever convinced of the correctness of their step. Besides, the formation of the combination has largely contributed towards surmounting the economic depression which prevailed during the winter of 1925–26. The adjustment of the conflicting interests as between the participating concerns resulting from the constitution of the combination has also had advantageous effects on the other iron and steel works in Germany. As to the further development of the situation, the report says that decisive influence in this respect will depend upon the question as to whether it will be possible to expand the International Steel Ingot Community—German, French, Belgian, Luxemburg and other countries—so as to be able to regulate the export markets, this implying the formation of export sales syndicates. The German steel industry stands in close connection with the Government in respect of this international syndicate policy, and it expects the adoption of an energetic foreign policy which would insure the conclusion of treaties of commerce on the basis of the admission of German goods into foreign countries according to the most favoured nation clause.

The report proceeds to state that any not unconditional centralisation has been avoided in the formation of the combination. Thus the works have been combined according to geographical and material standpoints, and have been placed under the responsible conduct of indi-

vidual members of the management, and sales, buying-in and administration have been organised in a similar manner. Through this division of work it is considered that the leading persons have been afforded the possibility of independent and responsible activity to a much greater extent than was formerly the case with the amalgamated concerns in their individual capacity. An extensive displacement of the working programme of the works has been rendered necessary for the purpose of securing greater economy in production and at the same time taking advantage of all freight facilities in consequence of the high railway rates. Taken as a principle, export orders have, as far as possible, been allocated to the Rhine works, which are particularly well situated for the export trade. On the other hand, the Westphalian works in the first place have been reserved for meeting the requirements of the neighbouring industrial region. The works which turn out the more highly finished manufactures have also been put under uniform management so as to get the most rational use of the plant possible. In this way special groups have been formed of all the tube works, all those producing wire rods and wire manufactures, and those rolling light sheets. Under the operation of these circumstances works and departments which were not economical in working have been definitely brought to a standstill, and the output transferred to the more economical works. The sales organisation has also been reorganised simultaneously with the production.

Dealing with the activity during the six months which terminated with last September, the report gives the following figures of the production in that period:—Coal, 11,823,000 metric tons in round figures; coke, 2,737,000 tons; pig iron, 2,273,000 tons; steel, 2,538,000 tons; rolled products, 1,924,000 tons; and castings, 152,000 tons. Leaving out of account the quantity of material consumed at the works of the combination, the total sales amounted to 2,203,000 tons of iron and steel, and of this quantity 1,042,000 tons were exported.

The directors of the company recommend the payment of a dividend at the rate of 3 per cent. for the six months out of net profits, which are stated to have amounted to 26,457,000 marks (£1,322,800).

SIXTY YEARS AGO.

SIXTY years ago, to quote from a leading article in our issue of March 29th, 1867, the inland telegraph system in this country was in the hands of "companies of irresponsible traders." British engineers and electricians had established for themselves the foremost place in the world in connection with telegraphy in general and submarine telegraphy in particular. But in the management of the inland telegraph systems that had been established we lagged far behind most countries. The companies owning and operating the lines were not under one control, and had to instal and operate their systems always with a strict eye to their shareholders' benefit. In communications with certain parts of the country a telegraph message would frequently have to pass over the lines of two or more companies, and as at each change it had to be transcribed from the Morse code into ordinary words, delay and the chances of considerable error were incurred. The position at the time at which we wrote was becoming worse instead of better. Progress was not resulting in a reduction of the fees charged by the companies. The fees had recently been considerably increased in some cases. Two years previously a telegram of thirty words could be sent from London to Edinburgh or Glasgow for a shilling, but the price had since been increased to two shillings. The principal towns in the country were beginning to take action in the matter. Edinburgh, Glasgow, Liverpool and other cities were beginning to object to the state of inefficiency, and were taking steps to petition the Government to institute a system of Post Office Telegraphs. The demand for a Government service was becoming widespread and to it, after close consideration of the problems involved we lent our whole-hearted assistance. The Liberal Government under Lord Russell, which had gone out of office in 1866, had favoured the proposal of taking over the companies' lines and working them as a branch of the Post Office. The new Government under Lord Derby was for the time being too absorbed in questions of political reform to pay much attention to the reformation of the telegraph system, but it was regarded as certain that in the near future the problem of telegraphic reform would have to be faced by whatever Government was in power. Actually three years or so had still to elapse before the country's telegraph system was made part of the Post Office organisation in 1870 under Mr. Gladstone's first Government. Writing before the event we anticipated that the change would result in the reduction of the fees charged to a uniform rate of not more than sixpence for thirty words. That it might be made still less was suggested by the fact that the Belgian Government found it possible to make both ends meet with a charge of fivepence for twenty words, including free delivery within a radius of 1¼ miles. By the employment of recent developments in the field of automatic typo-telegraphy we suggested that a uniform charge of 4d. even might be found profitable.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

AN OLD BEAM ENGINE.

SIR,—The engine shown in the accompanying photographs was built by Fenton, Murray and Jackson, of Leeds, in 1838, for the Castleton Mill. The mill, of which the first stone was laid on August 20th, 1837, was built at a cost of £30,000 by the late William Hargrave for three of his sons, who began business there as flax spinners. The machinery was supplied by Messrs. Maclea and March—who were sons-in-law of Matthew Murray—and the engine by the famous engineering firm already mentioned.

For very many years the business has been carried on by Messrs. Thos. Lenty and Co., and it is to Mr. T. H. Lenty, the senior member of that firm, I am indebted for the following interesting particulars concerning the engine:—

The cylinder was 33½in. in diameter, with a stroke of 6ft.; length of beam, 26ft.; and the fly-wheel had a diameter of 25ft.

With regard to the history of the engine during the last sixty years, I am informed by the present owners of the mills, that their grandfather bought the business about the year 1863, and since that date there have been no serious breakages or stoppages. The engine during the last twenty years of its life was very little trouble, running at about 23 revolutions per minute, with a boiler pressure of 30 lb.

The engine is said to have been put in for doing 40 horse-power; it was gradually loaded by extensions to the works by the late Mr. T. R. Lenty, father of the present owners, to about 120 H.P. Later additions by the present owners put the horse-power to about 180, when it was thought that the limit to even one of the most willing of "horses" was reached. So to relieve this good, old and faithful servant, a small horizontal engine was put in, which helped matters for a little while.

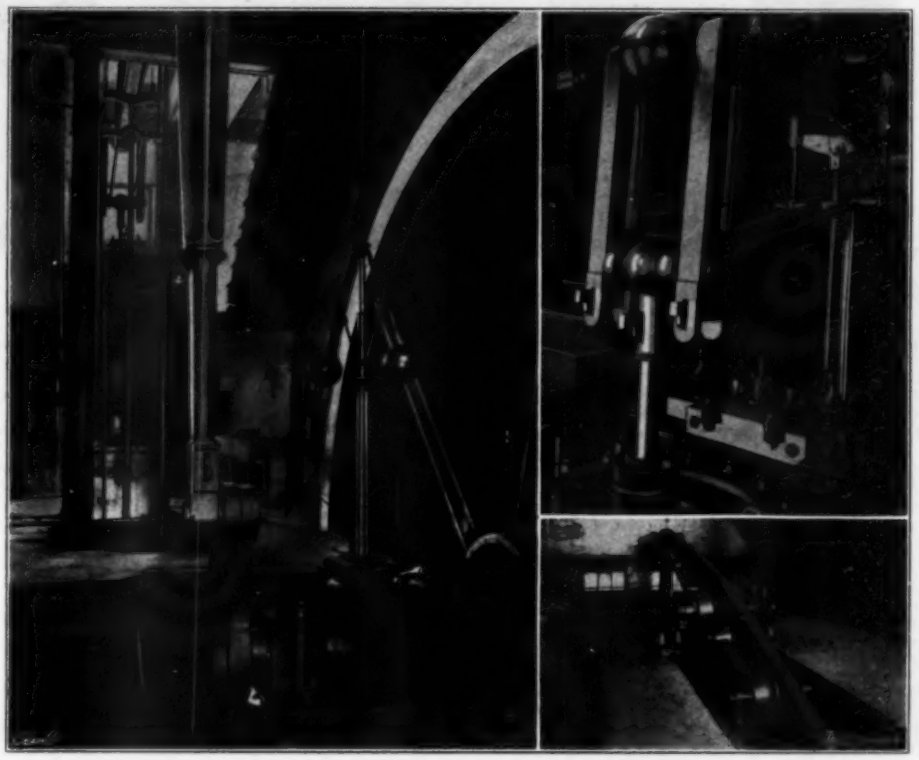
However, with work extending, the cry was still for more power, and in 1920 it was decided to replace the "old beam," together with the smaller engine by a Corliss engine of 450 H.P. The old beam engine used about 25–28 tons of coal per week of fifty-six hours at 140 H.P.; the beam and horizontal engine together used about 27–31 tons for the same time for 150–170 H.P. from two boilers. The new engine with one boiler, at a pressure of 80 lb. per square inch, 20–22 tons for a week of fifty-one hours.

The highest indicated horse-power was 181 at a boiler pressure of 30 lb. It was reduced to about 90 in 1913. These figures are not to be taken as exact, as the indicator diagram might be taken on a day when some weight was off, and there are also other matters which might make the figures not quite correct. They are, however, sufficiently convincing to show the very great economy obtained in present-day practice in the use of even saturated steam.

For the above particulars and for facilities so kindly afforded me to take the photographs, my thanks are especially due to Mr. T. H. Lenty, of Messrs. Thos. Lenty and Co., Castleton Mills, Armley-road, Leeds.

W. J. BARKER.

Leeds, March 10th.



BEAM ENGINE BUILT BY FENTON, MURRAY AND JACKSON IN 1838

CIMENT FONDU.

SIR,—I have read with very great interest your editorial referring to an article in *Le Génie Civil*, entitled "Observations sur une Maladie des Bétons de Ciment Fondu."

We have conducted several important experiments with a view to establishing the effect upon Ciment Fondu concrete of the heat which is developed by the cement during the chemical process of hardening, but the phenomenon noted by MM. Freyssinet and Coyne would appear to occur when the water used for gauging is at a considerable temperature, and when the atmospheric temperature during the period of hardening is also considerable.

I heartily agree, Sir, with your statement that further research into this matter is imperatively necessary, and I, therefore, propose to request the National Physical Laboratory immediately to carry out a series of experiments to that end.

I propose to suggest that cubes of concrete, gauged with fresh water at various temperatures, be broken at the age of twenty-four hours, after having been kept during that period in a moist atmosphere at the same temperature as the water used for gauging in each case. I shall further request that a thermometer be embedded in each cube and that readings be taken to establish the maximum temperature attained at the centre of each cube.

If it would interest your readers, I shall be only too pleased to submit to you the results of these tests when they have been carried out.

I do not propose to repeat the tests using the sea-water for gauging concrete (as was done by MM. Freyssinet and Coyne), as I consider that sea-water should never be used for this purpose.

May I, through the medium of your columns, extend an invitation to any recognised laboratory or institution in the country to investigate this matter independently? My firm, who are the manufacturers of Ciment Fondu, will be only too pleased to place such quantities of cement as they require for this purpose at their disposal, without charge.

JOHN G. KAY, Managing Director.

London, W.C. 1, March 30th.

DIRECTORY OF SOURCES OF SPECIAL INFORMATION.

SIR,—Just as the practical utility of a book is impaired by the want of an index, so the vast aggregation of knowledge that has been built up and *is* in many cases being added to day by day is largely lost to mankind owing to the lack of a master-key to its whereabouts. Throughout this country there are numerous centres of specialised knowledge and experience of the most varied description, the existence of which has only to be known for them to prove of great service to the world.

It is with the object of bringing these to light and recording their salient features in concise form that the Association of Special Libraries and Information Bureaux, in collaboration with the Carnegie United Kingdom Trust, has asked me to compile a directory.

It has been decided to go forward with the printing of a first edition of this directory at midsummer, but much still remains to be done. It is recognised that completion in any one subject is well-nigh impossible in so short a time. It would, however, greatly further this end if libraries, organisations, firms and individuals possessing special information on any subject and willing to answer inquiries thereon, which have not yet been in touch with us would communicate with me at 38, Bloomsbury-square, W.C. 1.

G. F. BARWICK,
General Editor, late Keeper of Printed Books, British Museum.

BRITISH STEEL AND RESEARCH.

SIR,—We notice in your issue of March 25th that in the report of the discussion on Mr. Heron Rogers' paper on the "cross" cracking process and plant, Dr. Ormandy made some remarkable statements. He is reported to have said that the investigations on "creep" had been ten times as adequately done in America and Germany as in this country, thereby exhibiting the deplorable mental attitude so common at present of decrying everything British. For his information, the phenomenon of "creep," which is so occupying the attention of responsible engineers, was first disclosed and investigated in Sheffield and has been continuously studied ever since. He went on to say that nickel chrome, straight chrome, vanadium chrome and molybdenum chrome steels were unobtainable in this country, but could be purchased in Germany and America. His knowledge of the past records and present achievements of the British steel trade, particularly in Sheffield, must, we fear, be limited.

JOHN BROWN AND CO., Ltd.,
ALLAN J. GRANT, Director.

Sheffield, March 28th.

A VERY important pronouncement on the subject of the responsibility for the use of level crossings was made on March 11th in a written answer by the Minister of Transport. He said that at an ordinary public road crossing the company is required, with a view to securing the safety of the public, to provide a crossing keeper to attend to the gates. At an occupation crossing, however, the company is under no such obligation, and in that case the persons entitled to use the crossing are, in the absence of negligence on the part of the railway company, responsible for their own safety.

Rotary Milling Machines in a Motor Car Engine Works.

We were recently invited to inspect at the Coventry engine works of Morris Motors (1926), Ltd., a battery of six large rotary milling machines employed for milling the cylinder block castings of Morris car engines. Three of the machines—see Fig. 1—are used for milling the bottom faces of the blocks and three—see Fig. 2—for milling the tops. In addition, in the second-named group room is found between the blocks for the cylinder head castings.

The work indicated was formerly done on planer type milling machines. It was decided to change to machines with rotary tables because such machines would permit of continuous loading and because, with the increased rigidity and simplicity of their construction, they would result in the elimination of vibration and consequently give an increased life to the cutters. The machines were designed by the firm's own staff and were built by William Asquith (1920), Ltd., Halifax. It is of interest to learn that all the six machines were installed and at work within a little less than six months from the date on which the designs were begun. Throughout the design care was exercised to ensure that the finished machines would require little attention in their upkeep and operation, and be capable of running continuously for 22½ hours per day, the firm's working hours in normal times.

Certain general features of the design may here be noted. Provision is made for altering the speed of the cutter spindles and the rotary feed of the work table. Since, however, the machines are employed on repetition work, the design of which is not subject to frequent or great alteration, gear-boxes for changing the cutting speed and feed would be out of place. Both the speed and the feed are changed by replacing a pair of gear wheels by another pair. By means of the change wheels provided, cutting speeds ranging from 30ft. to 112ft. per minute and feeds from 2¼in. to 12in. per minute are obtained.

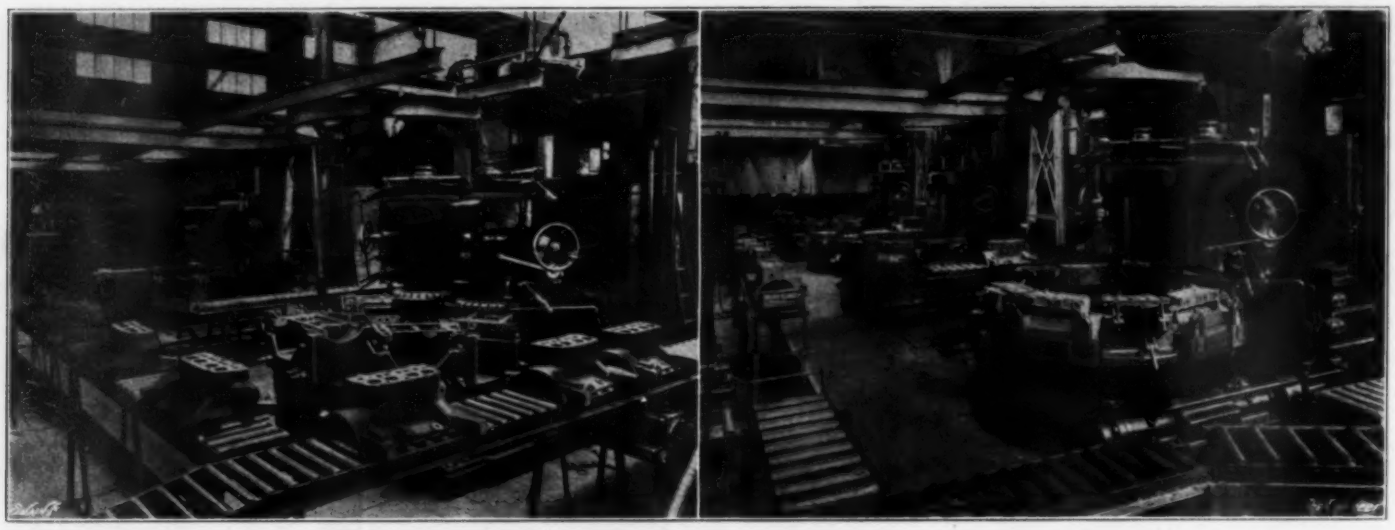
Each machine has two spindles, both equipped with an inserted tooth facing cutter. The first cutter takes a roughing cut, and the second a finishing cut. The machines are arranged back to back in two rows of three each. The castings are brought to the machines of the first row by means of an overhead runway, and are positioned in box jigs attached to the tables. After the bottom faces have been milled, the castings are sent on a roller pathway through to the machines of the second row, where, after being inverted, they are milled on the top. Thereafter they are removed by a runway on to a roller path and dispatched to the scene of the next operation, the drilling and boring of the various stud and other holes.

There are no loose keys on any of the shafts in the machine, all the keying being done by means of solid splines. The only exception is to be found on the motor spindles. The ordinary loose key is employed on these spindles, only because insistence upon a solid spline would have meant the provision of a special rotor shaft.

The lubrication of the machines is on a very generous scale. All the bearings are flood-lubricated by a plunger pump situated in the machine base. This pump circulates no less than 30 gallons of oil per minute under a pressure which is sufficient at places to make the oil escape into the atmosphere in the form of an atomised spray.

All the worms in the machine are hardened and ground, and in the case of the table drive, which is by worm and worm wheel, all the gearing and bearings run submerged in oil. The final drive to the spindles is transmitted through heavy double helical gearing.

The machines, as will be seen from the views on page 356, consist of a base casting carrying the table at the front and a vertical column at the rear, on which, in turn, the two cutter heads are mounted to slide vertically, but without cross adjustment. Each head is complete in itself, and can be dismantled from the machine as a unit. When the cutter spindles are in their highest position the work table can be removed without dismantling any other part. The worm driving the table, together with its housings, can be detached by disconnecting the coupling which drives it and all the gear-boxes can readily be removed in the event of a breakdown.



FIGS. 1 AND 2—BATTERY OF MILLING MACHINES FOR FACING MOTOR CAR CYLINDER BLOCK CASTINGS

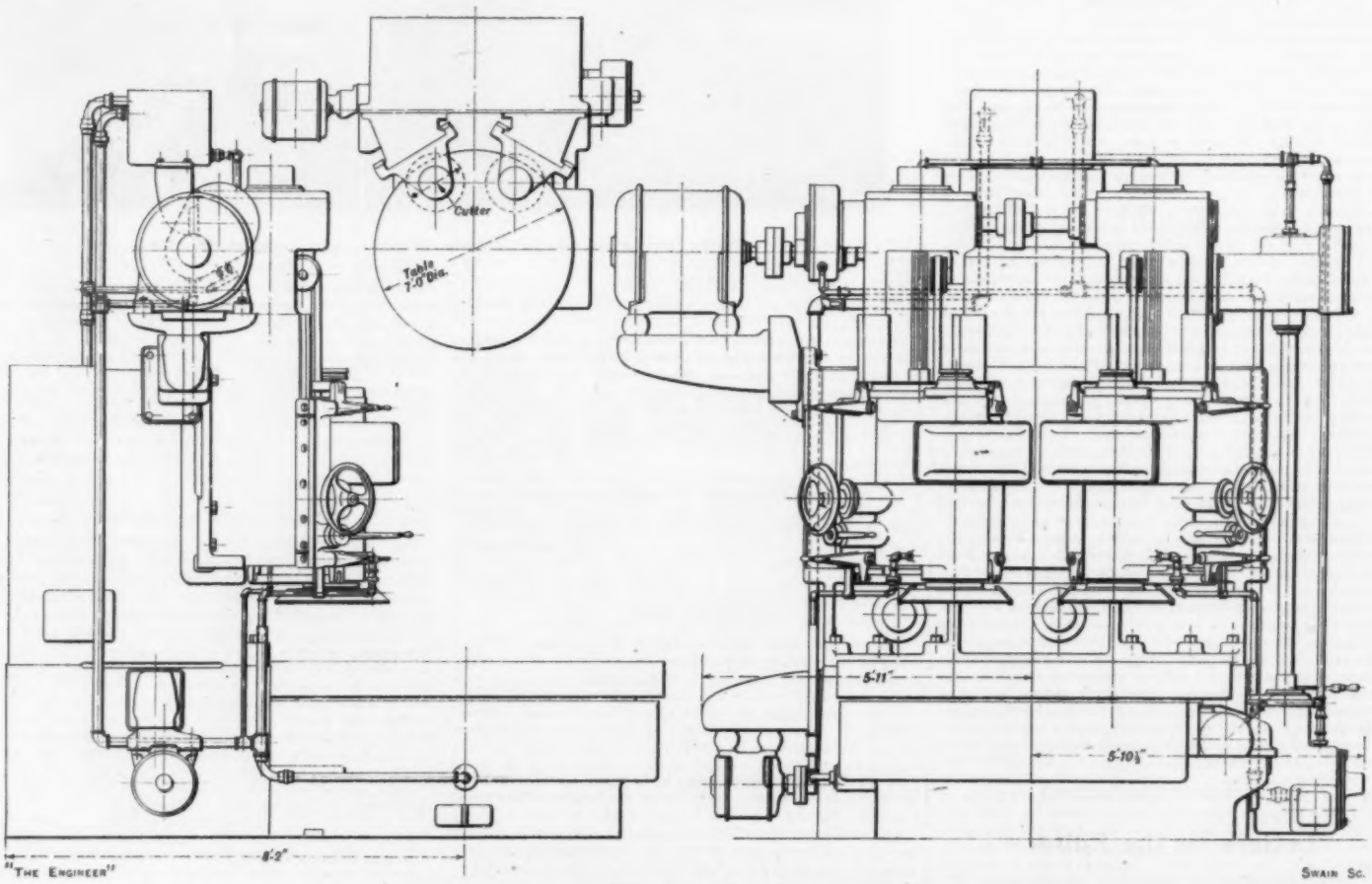


FIG. 3—GENERAL ARRANGEMENT OF ROTARY MILLING MACHINE

The drive is effected by means of a 25 horse-power "Klosd" type Parkinson motor, mounted on the top left-hand side of the column. The drive is transmitted through a pair of wheels at A—page 356—which may be changed when a change is desired in the spindle speed. The shaft of the second or upper wheel drives the spindles through worm gearing. The shaft of the first or lower wheel is continued across the back of the machine into the gear-box B on the right. This box contains a pair of feed change gears, which, through worm gearing, drive the

vertical shaft C. The drive then passes into the gear-box D, and thence through worm gearing to the coupling and box E containing the worm which drives the table. A clutch is provided in the box D to make and break the feed drive. When this clutch is disengaged, fast rotary motion for setting purposes can be given to the table in either direction, the power required being taken from a small separate motor F on the left. This fast motion can be engaged whether the spindles are running or stationary, but provision is made whereby the press buttons controlling the small motor become dead when the feed clutch in the box D is in the engaged position. By this arrangement of electrical interlocking between the feed and the rapid table motions it is ensured that the small motor will not be called upon to drive the machine as a whole.

The cutter heads are balanced by weights. They are raised and lowered by means of a hand wheel fitted with a micrometer dial, which is graduated in thousandths of an inch. The heads are mounted on long narrow guides, and are locked in position at each of their four corners, as well as by a long taper gib.

A general arrangement drawing of the machines is

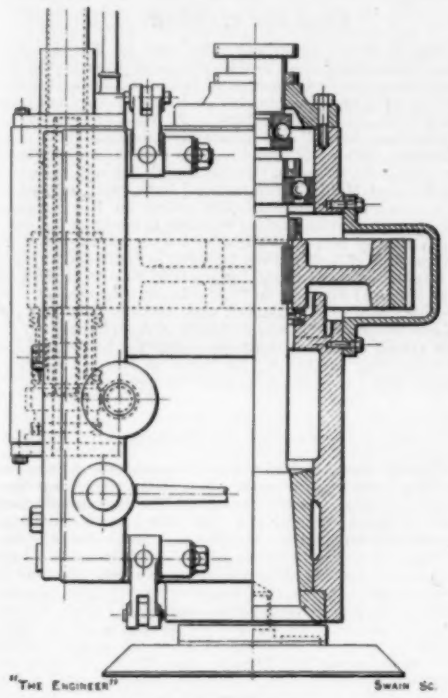


FIG. 4—CUTTER HEAD

reproduced in Fig. 3, and in Figs. 4–8 we illustrate some of the details. Fig. 4 shows one of the cutter heads. The lower bearing of the spindle is in the form of a double cone, while the upper one is of the radial ball type. The weight of the spindle is taken on a ball thrust bearing situated immediately below the double helical wheel, which drives the spindle. The upward thrust on the spindle is taken on a heavy ball thrust bearing at the top end, which reacts against a screwed plug provided for adjustment purposes. Behind the main driving wheel is a double helical pinion, which is held in long bearings, and which is driven from a splined shaft depending from the top of the machine. The splined shaft telescopes through the pinion as the head is adjusted vertically. At the top end the splined shaft is driven by the worm wheel and worm represented in Fig. 5. The shaft and the worm wheel are supported on a double row radial-thrust ball bearing. It will be seen that the shaft can be withdrawn from the top of the machine without dismantling the cutter head. Attention may be directed to the inspection cover, provided in the casing

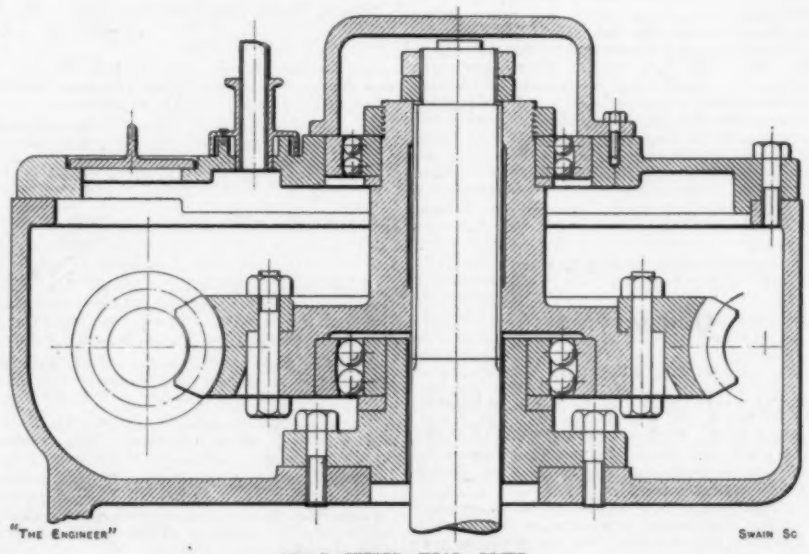


FIG. 5—CUTTER HEAD DRIVE

over the worm and to the adjacent pipe, whereby oil is admitted into the box.

The gear-boxes A and B—see page 356—are fairly straightforward in design. The only point we need note about them is that in the box B controlling the feed, a spring-loaded dog clutch is provided, which slips in the event of the table feed being overloaded. The noise made by the slipping of this clutch is stated to give the operator ample warning that the feed is excessive.

The gear-box D—page 356—is shown in detail in Fig. 6. The vertical shaft C from the top gear-box transmits power through bevel gearing and a dog clutch to a worm shaft Y, and thence through a large worm wheel to the table worm. On the outside of the bevel gear on the shaft Y a wheel is formed. This wheel drives the plunger pump, which provides the flood of lubricating oil for the whole machine. The shaft Y is continued across the machine,

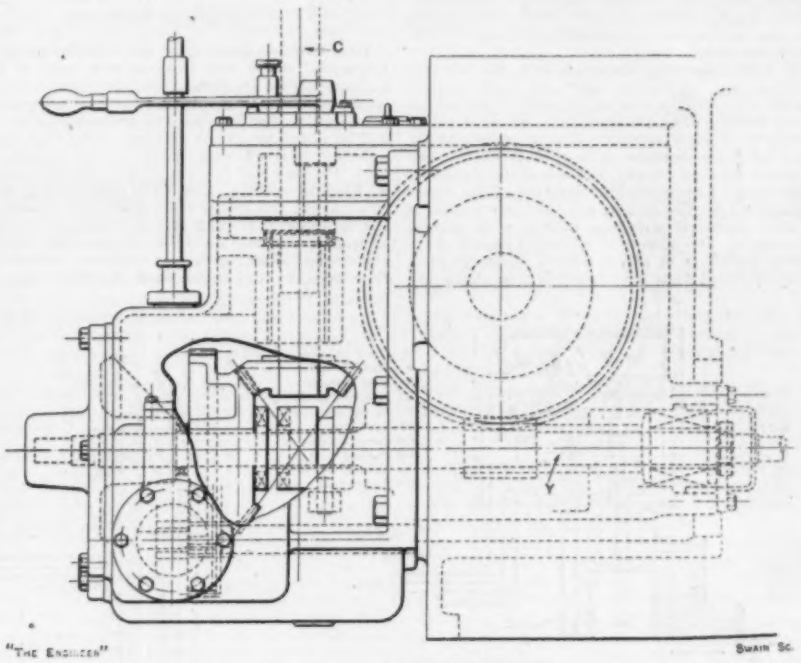


FIG. 6—GEAR BOX OF TABLE DRIVE

and at the opposite side is coupled to the small motor F —page 356—used for the rapid adjustment of the table.

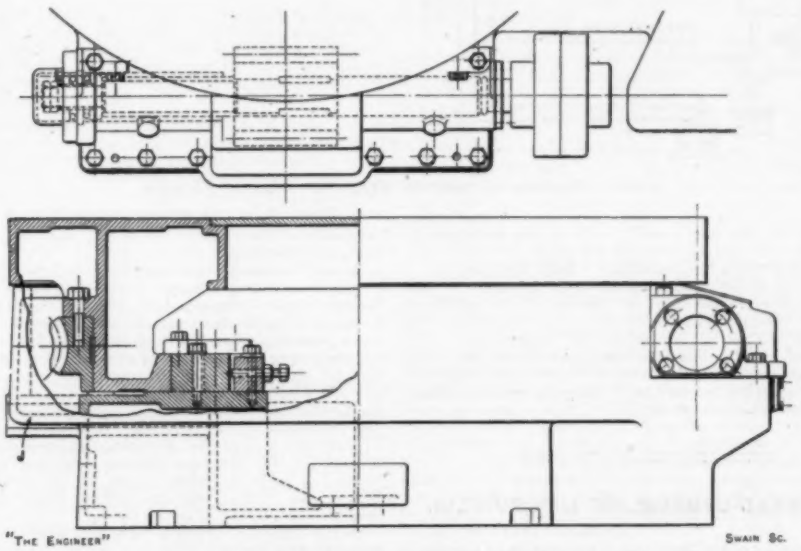


FIG. 7—TABLE AND TABLE WORM DRIVE

The table and its worm drive are shown in Fig. 7. The worm wheel is fixed by studs to a lip external to the main body of the table. The table bearing, it may be noted, is on the bottom face of the table itself, and not on the worm wheel. Provision is made for the radial adjustment of the table by means of pads mounted on the base of the machine, and capable of being adjusted and locked by set screws and studs. The depth of oil carried in the base is sufficient to submerge the worm wheel, the table bearing and the central spigot. The oil returning from the higher parts of the machine enters the base through the cored passage J. From the reservoir and separating chamber formed by the base, the oil is taken by the pipe G—page 356—to the strainer H, and thence to the plunger pump already referred to.

The main 25 horse-power motor is of the Parkinson two-phase, 200-volt, 50-period, alternating-current type with slip rings. The 5 horse-power motor is of the Parkinson squirel-cage, alternating-current pattern. Both motors are totally enclosed, so that metallic dust cannot reach their windings. They are operated exclusively by push-button controls, and are mechanically and electrically interlocked in such a way that they cannot both be set at the same time to drive the table.

The electrical control gear was supplied by the Highfield Electrical Company, Ltd., of Coventry, and is represented diagrammatically in Fig. 8. The slip rings of the main 25 horse-power motor are permanently connected to a patented "Eddystat" electric starter, made by Electric Control, Ltd., Glasgow, and consisting of a three-core iron choke containing a three-phase winding. A contactor is provided for short circuiting the starter when the machine has been run up to speed. It is claimed that by this arrangement the control is greatly simplified, and that the gear on the contactor panel required for push button operation is reduced to the smallest amount possible. The operation of the starting button connects current to the contactor switch controlling the starter circuit, and as a result switches the motor on to the line. The "Eddystat" starter is then adjusted to allow sufficient current to pass to accelerate the milling machine up to its working

speed without excessive current being passed through the motor. When the machine is up to speed the current relay provided in the rotor circuit operates to close the short-circuiting contactor. As a result, the "Eddystat" starter is short circuited and losses therein are prevented. The customary magnetically operated overload relays, with an inverse time limit device are provided for the effective protection of the circuit.

The push button control associated with the 5 horse-power motor is used for inching the table backwards or forwards when the cutters are being adjusted or for similar duties. Two buttons only are provided, one for forward and the other for reverse motion. The motor runs only while either of these buttons is kept depressed. The buttons operate two electrically and mechanically interlocked contactors for reversing the direction of the motor in the ordinary way. The motor, like the main motor, is provided with magnetic overload relays, with inverse time limit devices. The push button control circuit of the 5 horse-power motor is in series with a normally open mechanically operated limit switch, which is mechanically

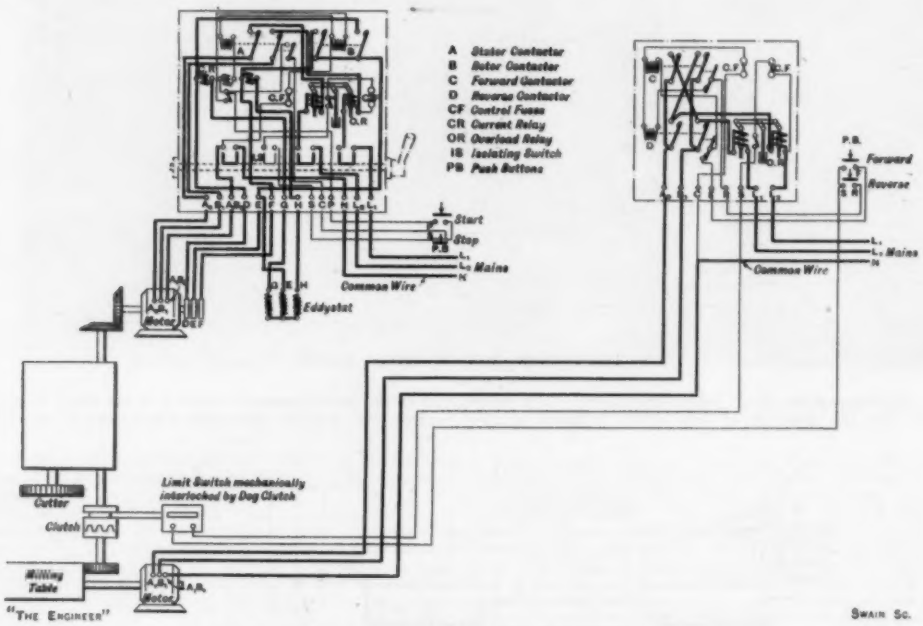


FIG. 8—ELECTRICAL CONTROL GEAR OF MILLING MACHINE

connected to the dog clutch lever in the gear-box D. In this way the control circuit of the small motor can only be completed when the dog clutch is fully withdrawn.

The whole of the control apparatus is mounted on slate panels in sheet metal cases on the top of the machines. The cases have detachable covers, so that all parts of the apparatus are easily accessible for adjustment. The "Eddystat" starter has to fulfil a somewhat unusual duty, but, we are informed, the manner of its employment has been fully justified by the trustworthiness and smoothness of operation which has resulted.

INTERNAL COMBUSTION LOCOMOTIVES.

At a meeting of the Manchester Association of Engineers held on Friday, March 25th, at the Engineers' Club, Manchester, a very comprehensive paper on "Internal Combustion Locomotives," was read by Mr. G. E. Windeler, M.I. Mech. E. The author described the principal features of the Sulzer direct-coupled oil locomotive, the Kitson-Still direct-coupled oil and steam locomotive, the Buchli oil and steam locomotive, the Esslingen oil and steam locomotive, the Diesel-electric locomotive on the Lomonossoff system, the Beardmore oil-electric locomotive, and the Sulzer oil-electric locomotive. He said that in countries where fuels of all kinds were imported, or where fuel oils were indigenous, the oil locomotive in one or other of the forms described appeared to be the most satisfactory means of reducing the high operation costs of railways in those countries. Admittedly, he said, the first cost appeared high, but the period of running service without overhauls was longer and hence fewer locomotives, as compared with steam locomotives, would be required, smaller repair equipment, fewer sheds, watering, and fuel depôts would be necessary, and as comparatively bad water could be used without causing serious difficulty or affecting the repairs bill materially, that item need not give anxiety. Referring to the petrol-electric vehicles which have been in use on railways in this country for many years, Mr. Windeler said that the high fuel costs precluded that type from being considered for the higher powered units, but for shunting locomotives and locomotives for branch lines and a certain class of suburban traffic, the high compression oil-electric unit would well repay consideration. In the event of our main lines being "electrified," locomotives built on such lines could operate on the power available and yet be independent when working on their own special services. In that respect the author thought that the shunting locomotive which was only in operation for a very short period of time would be an admirable example for adaptation of the oil-electric unit as the stand-by losses would be reduced to zero, and yet the locomotives would always be ready for service without any previous preparation.

The paper was well illustrated, and its reading was followed by a lengthy discussion.

Institution of Electrical Engineers.

SUMMER MEETING.

The summer meeting of the Institution of Electrical Engineers, which was to have been held at the North-Eastern Centre in June, 1926, and had to be postponed on account of the general strike, will take place at that Centre from June 14th to 17th, inclusive. The programme will be as follows:—On Tuesday, June 14th, there will be morning and afternoon visits to the Heaton Works of C. A. Parsons and Co., Ltd.; and the Hebburn Works of A. Reyrolle and Co., Ltd. The party will be divided into two groups, the group visiting Messrs. Parsons' works in the morning will visit Messrs. Reyrolle's works in the afternoon, and *vice versâ*. In the evening there will be a civic reception at the Oxford Galleries, New Bridge-street, Newcastle, by the Right Hon. the Lord Mayor of Newcastle-upon-Tyne (Councillor A. W. Lambert, M.C.) and the Lady Mayoress.

On the Wednesday morning there will be a visit to the North Tees Power Station of the Newcastle-upon-Tyne Electric Supply Company, Ltd., and Associated Companies. In the afternoon there will be the following alternative visits (starting from North Tees):—(1) The main party will proceed to Durham, where they will visit the cathedral, the Old Monastery with its fourteenth century kitchen, and the library, which contains the Cuthbert relics and the Lindisfarne Gospels. (2) A subsidiary party will visit the Blackhall Colliery of the Horden Collieries, Ltd. To meet the wishes that have been expressed by visitors at some of the previous summer meetings, it has been decided to make no formal plans for the evening of this day, so that visitors who have friends in the district may have an opportunity of seeing them.

On the Thursday morning there will be alternative visits to:—(1) The Elswick Works of W. G. Armstrong, Whitworth and Co., Ltd.; and (2) the Ford Potteries of C. T. Maling and Co., Ltd.; and in the afternoon alternative visits to:—(1) The Wallsend Shipyard of Swan, Hunter and Wigham Richardson, Ltd.; (2) the Ford Potteries of C. T. Maling and Co., Ltd.; and (3) the new library of Armstrong College, Newcastle-upon-Tyne. In the evening there will be a reception and dance at the Old Assembly Rooms, Westgate-road, Newcastle, the party being received by Sir Theodore Morison and Lady Morison, supported by the Council of Armstrong College.

On Friday, the 17th, there will be alternative visits in the morning to:—(1) The new steel works and rolling mills of the Consett Iron Company, Ltd.; and (2) Hexham and the Abbey. In the afternoon the two parties will unite for a visit to the Roman Wall and the Roman Camp of Borcovicus, and will return *viâ* the line of route of the Roman Wall, Chollerford (on the North Tyne), and the Western Turnpike. In the evening there will be a reception and dance at the Grand Assembly Rooms, Barras Bridge, Newcastle.

Obituary.

F. W. M'CULLOUGH.

It is with regret that we learn of the death, on Monday, March 28th, of Mr. F. W. M'Cullough, the Chief Waterworks Engineer to the Belfast City and District Water Commissioners, who was for over half a century associated with engineering undertakings connected with Belfast water supply schemes.

Mr. McCullough was first of all trained as an architect and later gained engineering experience in the office of Mr. L. L. Macassey, who was then the Consulting Engineer to the Belfast Water Commissioners in connection with the Stoneyfield District and Woodford District works in Co. Antrim. Mr. M'Cullough subsequently became chief assistant to Mr. Macassey, and in 1895 he was appointed Waterworks Engineer to the City of Belfast. Since that time he had been responsible for the design and construction of reservoirs, filters, conduits and tunnels connected with the Belfast supply undertakings. In recent years much of his time was spent on the important works connected with the Mourne Mountains water supply scheme for Belfast.

Mr. M'Cullough's work was known in all parts of Ireland, and he advised upon and assisted in preparing many provincial water supply schemes. In his earlier days he also designed and constructed harbour and sewerage works and railway undertakings. It was Mr. M'Cullough, we believe, who first proposed the idea of a tunnel between Ireland and Scotland, which was planned to be driven from the Antrim to the Wigtownshire coast. In 1889 he joined the Institution of Civil Engineers and became a member in 1896. That same year he was also elected a member of the Institution of Water Engineers and he became its President in 1915, continuing his term of office until 1919 and rendering the Institution valuable service in the difficult years of the war period. The loss occasioned by his death will be deeply felt by members of his profession and many friends in the city of Belfast.

EVERARD R. CALTHROP.

Mr. Everard Calthrop, who died on Tuesday last, came into prominence during the later years of the war and subsequently by reason of his invention and manufacture of a parachute which could be used as well from aeroplanes as from airships. It was known as the "Guardian Angel," and numerous demonstrations of its efficiency were made, but for some reason or other, which has not been revealed, the Air Board did not take to it kindly, and Mr. Calthrop suffered both great disappointment and some financial loss owing to this unhappy adventure. But long before he began to study air transport Mr. Calthrop had been connected with railways and did a great deal of light railway building in India and at home. A familiar example of his designs is to be seen in the Leek and Manifold Railway in Staffordshire. In another connection, indirectly concerned with transport, he was also widely known, for he was a breeder of Arab horses and was the author of one of the most delightful books on those animals ever written, "The Horse as Man's Companion and Friend," if we remember the title aright.

GEORGE THOMAS.

By the death of Mr. George Thomas, which occurred on March 22nd, at his home, Irlam Hall, Irlam, near Manchester, a large number of engineers in this district have lost a good friend and the inhabitants of Irlam a generous benefactor. Mr. Thomas was a versatile man of business as well as an engineer, and had spent a large portion of his career in travelling abroad. He had a controlling interest in the Manchester machinery shipping firm of George Thomas and Co., and, as an expert in international patent laws, he had frequently acted as intermediary between inventors and foreign patent offices. For many years Mr. Thomas was Messrs. Dobson and Barlow's representative in Russia, and was also British secretary to the Constantinople Chamber of Commerce. He was a founder member of the Engineers' Club, Manchester, and a handsome bequest of shares in the club company made by him some years ago was the foundation of a scheme for helping the sons of deceased members to obtain education as engineers.

BOOKS RECEIVED.

Gas Meters. By A. T. Gilbert. London: Crosby Lockwood and Son, 7, Stationers' Hall-court, E.C. 4. Price 7s. 6d. net.

Amerikas Dampfturbinenbau. By Professor Dr.-Ing E. A. Kraft. Berlin: V.D.I. Verlag G.m.b.H., N.W. 7. Price 14 marks net.

Sewage Works. By F. C. Temple. London: Crosby Lockwood and Son, Ltd., Stationers' Hall-court, E.C. 4. Price 5s. net.

The Electricity (Supply) Act, 1926. By J. C. Dalton. London: Butterworth and Co., Bell Yard, Temple Bar, W.C. 2. Price 10s. 6d. net.

Electric Switch and Controlling Gear. Third edition. By C. C. Garrard. London: Ernest Benn, Ltd., 154, Fleet-street, E.C. 4. Price 63s. net.

The Economic Basis of Fair Wages. By J. D. Cox, jun. New York: The Ronald Press Company, 15, East 26th-street, N.Y., U.S.A. Price 3·50 dollars.

Controllers for Electric Motors. Second edition. By H. D. James. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 21s. net.

Chemical Engineering and Chemical Catalogue. Third edition. Edited by D. M. Newitt. London: Leonard Hill, 173, Fleet-street, E.C. 4. Price 10s. 6d. net.

"Proceedings" of the South Wales Institute of Engineers. Volume XLII. *Also List of Members.* Cardiff: The South Wales Institute of Engineers, Park-place. Price 5s. net.

Introduction to Reinforced Concrete Design. By H. Sutherland and W. W. Clifford. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 20s. net.

Machine Design, Construction and Drawing. Sixth edition. By H. J. Spooner. London: Longmans, Green and Co., Ltd., 39, Paternoster-row, E.C. 4. Price 21s. net.

The Electricity (Supply) Act, 1926. By E. J. Rimmer and G. Read Allen. London: The Solicitors' Law Stationery Society, Ltd., 104, Fetter-lane, E.C. 4. Price 12s. 6d. net.

Annali dei Lavori Pubblici gia Giornale del Genio Civile (Ministero dei Lavori Pubblici, Consiglio Superiore). Anno LXIV., No. 12. Dicembre, 1926. Rome: Provveditorato dello Stato Libreria. 1926.

Mechanics Applied to Engineering. Two volumes. Ninth edition. By J. Goodman. London: Longmans, Green and Co., Ltd., 39, Paternoster-row, E.C. 4. Price, Volume I., 14s. 6d.; Volume II., 16s. net.

Railway Matters.

The Southern Railway is spending £100,000 on converting the Westinghouse brake on the Brighton section to the vacuum, so that the engines and coaches on all three sections may be interchangeable. At the annual meeting of the railway company the chairman said that the work was well in hand.

When mentioning at the recent annual meeting of the London, Midland and Scottish Company, the increase in rates effective from February 1st, Sir Guy Granet said that the railways were not imposing all the increases at once; they were giving time in certain quarters and watching very carefully to see that no undue handicap was imposed upon particular industries.

During the coal dispute a certain number of locomotives on the Southern Railway were equipped for the burning of oil fuel and did good service. The experience gained, however, amply confirmed the company's previous conclusions, viz., that there must be a considerable reduction in the price of oil fuel before it could compete on equal terms with coal in the running of locomotive engines.

Certain interests in the North of Ireland are anxious that the mails for Belfast, Ulster and County Down should be sent through a northern port rather than through Kingstown. It is suggested that Killough Harbour, near Ardglass, in County Down, should be developed. The Harbour Commissioners say that a modicum of dredging in the elemental clay would remove the only existing barrier in the way of this most desirable object. Killough is on the Belfast and County Down Railway, and 34 miles from Belfast.

The three new twin-screw steamers for the Heysham-Belfast service, mentioned in our issue of March 18th, are to be built by Denny Brothers, of Dumbarton. They will be 360ft. long, instead of 340ft., the length of the present boats, and will have a 12ft. greater width of beam. Each boat will have 150 single-berth cabins, also *suites de luxe* with shower baths and hot and cold water. The speed will be 21 knots, and among the life-saving equipment will be a motor lifeboat. Fleetwood will still have its Isle of Man traffic.

Speaking at the annual meeting of the London and North-Eastern Railway, Mr. Whitelaw, the chairman, said that in the light of after events, it might be said that the company contracted too largely and too far ahead in the matter of foreign coal. But the results of the railways coming to a standstill would have been so grave to the interests and general welfare of the nation, as well as probably prejudicial to a settlement in the coal industry, that he did not think that the company did more than its duty in making ample provision against such a catastrophe.

In mentioning that the reconstruction of Aldgate Station had been completed, the chairman of the Metropolitan Railway told the shareholders the other day that the increased revenue the company was receiving from letting premises on stations was really remarkable; it was a very good interest on the whole of the outlay in the case of every station that had been rebuilt. At Edgware-road, benefit was being derived from the extra accommodation. The contractors were busy building on the street level, and it was hoped to have flats and shops there in the course of a few months. Plans had also been approved for modernising the stations in a similar way at Swiss Cottage and Notting Hill-gate.

Last Friday, March 25th, was the fiftieth anniversary of an accident which was most unusual in its results. As the East Coast night train from Edinburgh to King's Cross was passing through Morpeth, the engine and all the thirteen coaches except the last vehicle were derailed. After the accident it was found that a rail, with three chairs, had been driven through the end of the smoke-box, the leading wheels of the third coach, together with a passenger's body, were in the tank of the tender, and the wreckage was so complete that the parts of some of the carriages could not be identified. Five passengers were killed. The cause was a weak track brought about by a thaw after a long severe frost.

A deputation from the railway companies and the railway trades unions waited upon the Chancellor of the Exchequer on March 22nd to point out the serious situation created by the unfair road motor competition to which the railways were subjected, and to suggest certain measures for alleviating the position. An interesting point was made by Mr. Whitelaw. It was that great new roads were being built out of public money without the railways having an opportunity of stating their case. Any railway developments, on the other hand, had to be submitted to most exhaustive consideration by Parliament. Mr. Churchill, in his reply, when dealing with the last point, said that he also agreed that there was a great deal of substance behind the argument in favour of increased parliamentary control over road schemes and expenditure.

A Bill will be introduced in the Canadian House of Commons by Hon. Charles A. Dunning, Minister of Railways, embodying a programme for the construction of branch lines, suggested by the management of the Canadian National Railways. The list embraces sixteen lines with a total length of 470 miles, the cost of which is estimated at 19,120,000 dollars. Parliament will be asked to authorise the Canadian National Railways to proceed with the construction of these lines during the next three years, the work to be finished by August 31st, 1930. Most of the projected lines are intended to open up new agricultural districts in Western Canada. Among the more important of them are:—Sturgis to near Presana, Sask., 100 miles to cost 3,395,000 dollars; Shellbrook or near Parkside, westerly, Sask., 37 miles, 1,200,000 dollars; Turtleford, S.E., to between Hafford and Richard, Sask., 35 miles, 1,120,000 dollars; Hudson Bay Junction southerly to meet proposed Sturgis–Presana lines, Sask., 32 miles, 1,088,000 dollars; Hebertville to Savanna Falls, Lake St. John district, Quebec, 34 miles, 2,132,000 dollars; and Ashmont to Bonnyville, Alberta, 38 miles, 1,415,000 dollars. The measure may meet with some opposition, especially in the Senate, where some of the railway legislation introduced by the Government last year was thrown out.

Notes and Memoranda.

A proposal for damming the Lachlan River at Wyangala, New South Wales, for water conservation purposes, involves the expenditure of at least a million and a-quarter sterling.

By the close of the present year plants with a capacity of over a quarter of a million horse-power of hydro-electric energy will be installed on the Winnipeg River, Manitoba.

The first issue of the new *Journal* of the Commercial Motor Users Association includes an article by G. W. Watson on Lubricants, which gives some very useful hints on the practical testing of oils.

The scheme for the construction of an aerial ropeway, for passenger traffic, up the slope of Mount Hood, near Portland, Oregon, includes one single span of 6200ft., carried by a cable 2¼in. in diameter.

In order to scour out an increased depth of channel across the Hastings Shoal, below Rangoon, and to improve the Monkey Point Channel of the river, a training wall 6000ft. long by 32ft. wide is being built by the Port Commissioners.

The recently discovered tin ore deposit in the Northern Transvaal, some 40 miles from Naboomspruit, is said to extend for 1800ft. along the strike and to a depth of 100ft. below the surface. The ore assays 3·18 per cent. of metallic tin over a width of 37in.

A new form of heat insulating material with cork as a basis has been brought out by a British company, which is claimed to be superior to any other so far produced. Its peculiarity lies in the surface finish, which is glossy white and consequently minimises radiation losses.

If reports are true, the new find of gold on the western shore of Lake Victoria Nyanza, must be unusually rich. Thus it is said that samples taken over a width of 8ft., haphazard, have shown from 28 dwt. to 54 dwt., while one sample gave 607 dwt. of gold and 133 dwt. of silver per ton.

The power alcohol plant of the National Power Alcohol Company, near Mackay, Queensland, has been started up with a capacity of 1,000,000 gallons a year, but its output may be doubled if necessary. Two other plants, of similar capacity, are to be ready next year at Cairns and Townsville.

Work is proceeding on the replacement of the old bridge across the Coleron River, India, which was wrecked by the floods of 1924. The new bridge will consist of thirty-eight spans of 60ft. each, supported by brick well piers, and will be nearly a mile long. The original bridge was seventy-two years old.

The proposal for harnessing the Umtata Falls, South Africa, to provide power in place of the existing Diesel plant, which is driven by internal combustion engines, comprises the development of 100 kilowatts from a head of 91ft. with a minimum flow of 1140 cubic feet per minute. The internal combustion engines are to be kept as a standby.

One of the most recently issued Bulletins of the University of Illinois deals with the measurement of air flow in mines. It is pointed out that the recognised value of k in Atkinson's formula $R = k s v^2$ is too large at 0·0000000217 and gives as alternatives derived from actual experiment values ranging from 0·0000000046 to 0·0000000095 according to the condition of the airway.

The new newsprint mills at Bathurst, New Brunswick, will be in operation about 1930, and will employ about 1000 more hands than at present. The power developed will exceed 50,000 horse-power and will involve the expenditure of 9,000,000 dollars for storage basins and power plant. The output of the mills will be increased to six times their present capacity and will entail an expenditure of approximately 5,000,000 dollars.

A new electrical device for reclaiming particles of gold which formerly escaped up the flue of the smelting furnaces has just been installed in the Government Assay Office at New York. In tests, as much as 600 oz. of gold have, it is said, been reclaimed from 5000 lb. of dust extracted from the fumes. Electrical action drives the dust particles from the heavy gases, the dust is collected and the gold recovered by smelting again. Silver and platinum atoms are also arrested by the new device.

In a recent issue of the *Engineering News-Record* there is given an account of the erection of a 60in. penstock for a hydro-electric plant in California, which works under a maximum head of 2381ft. The joints in the pipe at the high-pressure end are made with flanges. The final tightening up of the nuts on the bolted joints was intended to get exactly uniform tension in the several bolts of each joint. Each bolt was tested by a superintendent with long experience in making such joints on high-head penstocks. His method of judging the tension was to tap the end of the bolt with a light hammer used solely for purposes of sounding. This test, depending upon the "musical ear" of an expert, was the sole and final test of tension in each bolt, and with this as a guide the nuts on bolts found slightly below the desired tension were turned up as much as the sound of the testing hammer indicated was necessary.

In discussing the problems of mine ventilation before the Ventilation and Dust Officers of South Africa, Mr. C. F. Raney said that tests extending over several years led to the adoption of canvas tubing entirely for use with the small fans. First it was found that air travelling at high velocities heats about twice as fast in galvanised iron as in canvas tubing. Next it was found that the coefficient of friction of canvas pipe is less than that of galvanised iron. This particular point is of no special importance. What engineer, he said, using the friction factor of either galvanised iron or canvas tubing can figure the amount of air a fan can deliver connected to the average installation of either tubing in a mine with its many twists and turns? It was found, however, that with canvas tubing more air could invariably be delivered to the face with the same fan with canvas than with metal tubing, and many lines are over 5000ft. long. Other advantages are that it can be placed more cheaply, it turns very sharp angle corners without elbows, and is more easily kept at the face.

Miscellanea.

Work has been resumed in the Allihies Copper Mines, Berehaven, Co. Cork.

A newsprint factory with an output of 400 tons a day is to be put up at Port Arthur, Ontario.

It is proposed to set out a measured mile in Dublin Bay for the speed trials of sea-going vessels.

The newsprint factory of the Manitoba Paper Company at Pine Falls, Winnipeg, is to be increased to have a capacity of 250 tons a day.

An electric crucible furnace, which, it is said, will be the first of its kind in this country, is to be put in operation in June by Edgar Allen and Co., Ltd.

The Cordeaux Dam, for the augmentation of the water supply of Sydney, has been officially handed over to the Water Board, and was put in service early in February.

It is announced from Brussels that the City of Antwerp is shortly to ask for tenders for the construction of three new graving docks. A rough estimate of the cost of the works is £1,150,000.

The gold yield for the State of New South Wales for the year 1926 amounted to 19,435 oz. fine, valued at £82,551, as compared with 19,422 oz. fine, valued at £82,498 for the previous year.

It has been decided to extend the Salt River Power Station, South Africa, by the addition of a fourth set of 10,000 kilowatts, and to proceed forthwith with the foundations necessary for a fifth unit.

Water powers in the Lillooet district of British Columbia, said to represent no less than 1,000,000 H.P.—the greatest power unit ever discovered in British Columbia—have been reserved by the Provincial Government.

Owing to the considerable weakening in the demand for coal, the small and medium-sized collieries in Hungary have decided to restrict coal-getting to three or four days per week. There are considerable accumulations of stocks at the pitheads.

According to a Dutch paper a Rotterdam engineer has produced a device which reduces the effect of rolling and pitching on gun-laying in warships. In a few weeks a Dutch warship equipped with the new device will make tests in the North Sea.

It has been decided by a Canadian Commission at Vancouver that a bridge across the Lions' Gate should be built. It is submitted that it should have a clear span of 1400ft., with a clearance above high water of 190ft., and that the channel should be dredged to a depth of 35ft. for a width of 1400ft.

In memory of the Swedish engineer, Mr. C. D. Ekman, who is credited with having discovered the sulphite cellulose process, the Swedish Association of Paper and Cellulose Engineers has decided to institute a fund to be termed the Ekman Fund, to encourage research work in the paper and pulp industries.

A Bill to construct a bridge across the Niagara River met with a stormy reception in a House of Commons Committee recently on the ground that it would spoil the scenic beauty of the Falls, says a *Daily Mail* cablegram. The Committee finally postponed consideration of the Bill to permit the promoters to decide on a site for the bridge further away from the Falls.

It is understood, states the *Ironmonger*, that Brunner, Mond and Co. intend to embark upon a scheme of reconstruction of the Winnington Chemical Works. The scheme will involve the employment of additional labour, and the company has asked the Northwich Urban Council whether it is prepared to negotiate a loan to defray the cost of erecting approximately 260 houses for workmen in its employ. Brunner, Mond and Co. will undertake the building of the property.

The Lexington Water Power Company, of Columbia, South Carolina, is making plans for an early start upon the construction of a large hydro-electric power plant on the Saluda River. The company proposes building an earth-fill dam, 8000ft. long and 188ft. high, which will create a storage reservoir, 30 miles long and 14 miles wide at the widest point. The ultimate installation of power equipment is stated to be 200,000 H.P. and the estimated cost of the completed project 20,000,000 dollars.

The tonnage of vessels entered into British India and cleared outwards with cargoes from and to foreign countries and British Possessions during the month January, 1927, amounted respectively to 698,000 and 607,000, as against 607,000 and 706,000 in December, 1926, and 665,000 and 641,000 a year ago. During the ten months ending January, 1927, the tonnage of vessels entered and cleared with cargoes amounted respectively to 5,741,000 and 6,483,000, as compared with 5,826,000 and 6,647,000 in the corresponding period of the preceding year.

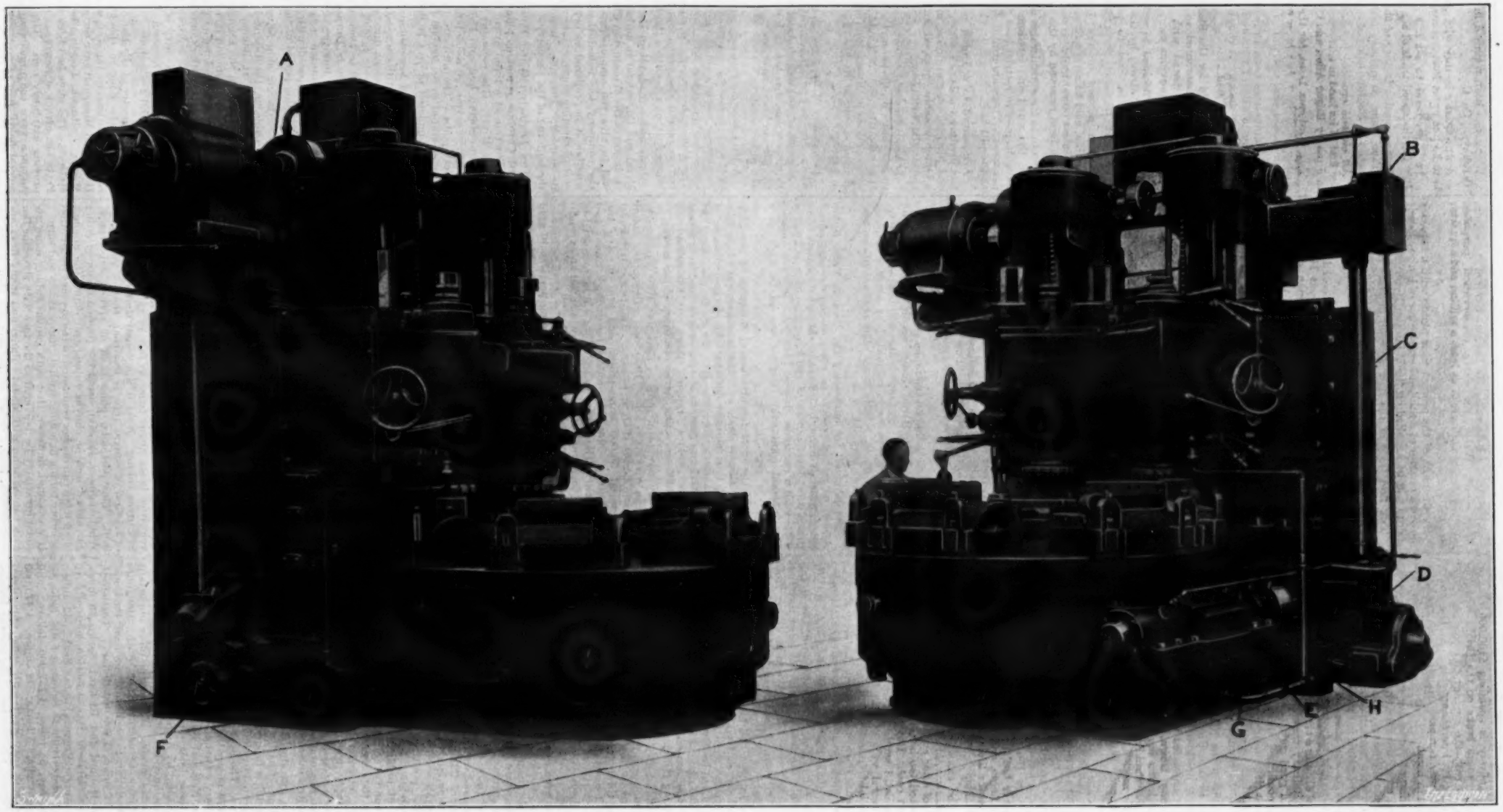
The cable-laying ship Silver Grey recently laid a new electric cable in the Channel. The starting point was Audresselles, near Boulogne, and the cable was brought out of the water on the English side at Sandgate. There are twenty-one circuits in it, of which four will be for use between London and Switzerland, the remainder being for various parts of the Continent. The cable cannot be used for a time, as the work on the French side is not yet complete. In this country it will be connected with an underground cable between London and Sandgate *viâ* Canterbury and Folkestone.

The Barmaster of the Barmote Court for Matlock, who represents the King in the Duchy of Lancaster, held a court, according to the *Ironmonger*, recently at the Jug Hole Lead Mine, and gave certain rights to the new owners, Messrs. Coltman, Loseby and Petts, of London and Matlock. The mine had been derelict since 1848, and Mr. Petts has struck a new vein of ore, 4in. thick, which is proving extremely rich. The Barmaster and two grand jurymen gave the mineowners a right of road through several fields, free of cost, and also the right to tipping land. Mr. Petts said that it was hard luck on the miners of generations ago that they had been so near as 9in. from the newly discovered vein without finding it.

ROTARY MILLING MACHINE FOR FACING CYLINDER BLOCK CASTINGS

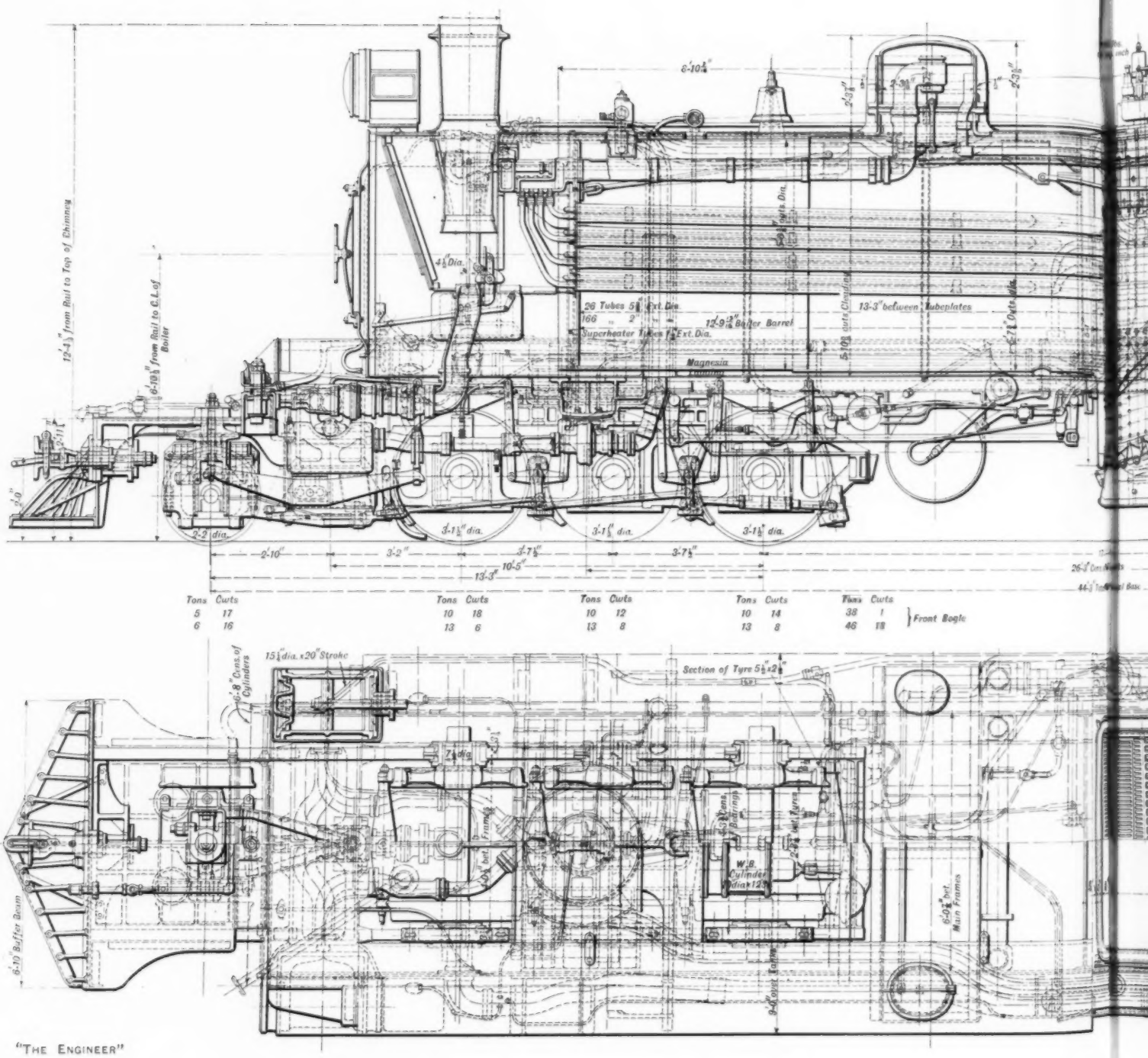
DESIGNED BY MORRIS MOTORS (1926), LTD., COVENTRY, AND MADE BY WM. ASQUITH (1920), LTD. HALIFAX

(*For description see page 352*)



GIRARDOT RAILWAY, COLOMBIA—KI

DESIGNED BY MR. P. C. DEWHURST, M.I. MECH. E. AND CON



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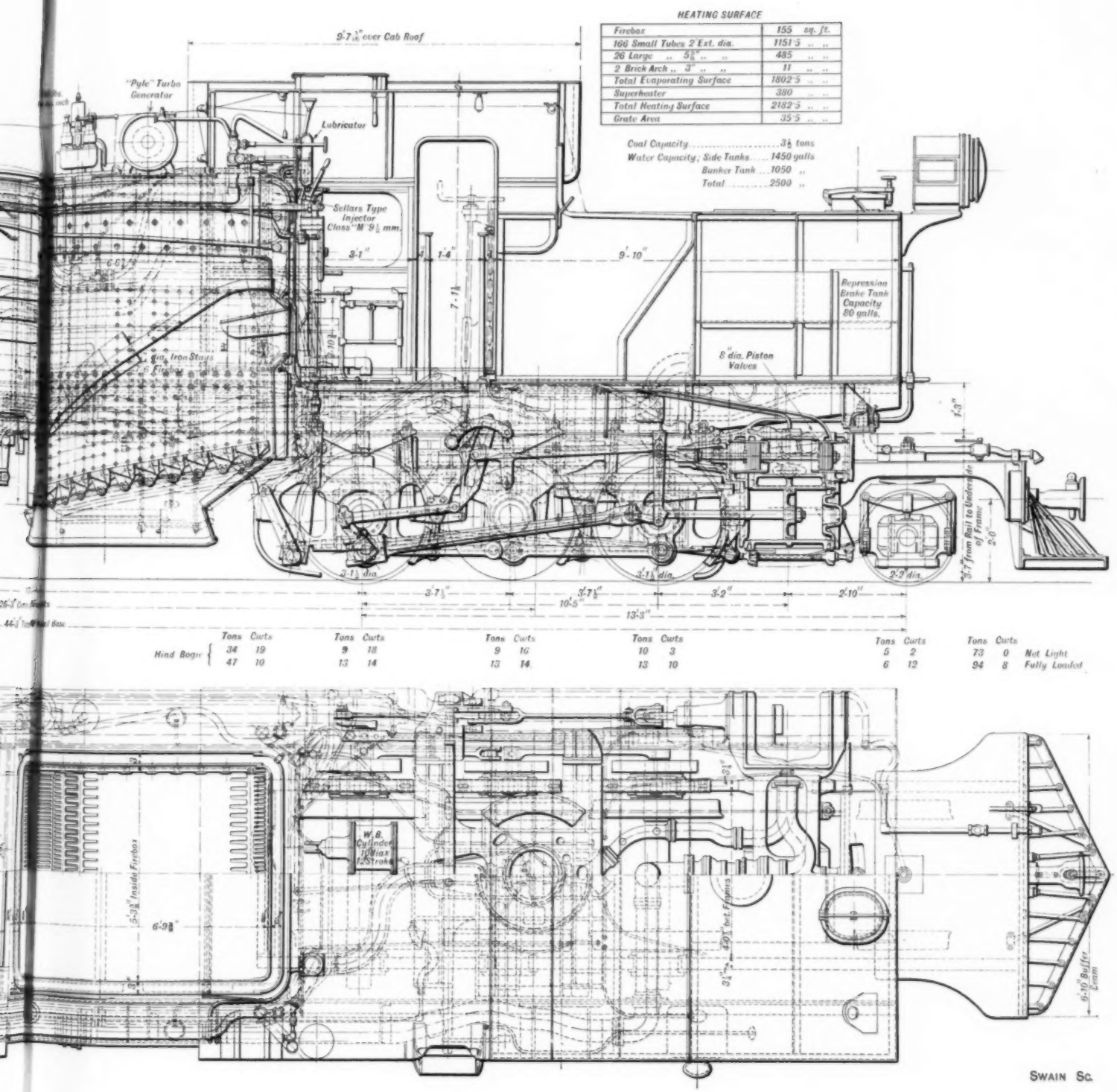

HEATING SURFACE

Firebox	155 sq. ft.
166 Small Tubes 2" Ext. dia.	1151·5 " "
26 Large " 5 5/16" " "	485 " "
2 Brick Arch " 3" " "	11 " "
Total Evaporating Surface	1802·5 " "
Superheater	380 " "
Total Heating Surface	2182·5 " "
Grate Area	35·5 " "

Coal Capacity ..... 3½ tons
Water Capacity; Side Tanks ..... 1450 galls
Bunker Tank .... 1050 "
Total ..... 2500 "

	Tons	Cwts	Tons	Cwts	Tons	Cwts	Tons	Cwts	Tons	Cwts	Tons	Cwts	
Hind Bogie	34	19	9	18	9	16	10	3	5	2	73	0	Net Light
	47	10	13	14	13	14	13	10	6	12	94	8	Fully Loaded

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Contents.

The Engineer, April 1st, 1927. PAGE

A Seven-day Journal 343
The World's Future Supplies of Liquid Fuels. No. V. .. 344
Delaware River Suspension Bridge, U.S.A. No. V. (Illus.) 345
The Steel Industry in South Africa 348
Scientific and Industrial Research 349
British Coal in France 350
The German Steel Combination 350
Sixty Years Ago 351
Letters to the Editor—
An Old Beam Engine—Ciment Fondu—Directory of Sources of Special Information—British Steel and Research 351
Rotary Milling Machines in a Motor Car Engine Works. (Illus.) 352
Internal Combustion Locomotives 354
Institution of Electrical Engineers 354
Obituary—
F. W. M'Cullough—E. R. Calthrop—G. Thomas 354
Books Received 354
Railway Matters—Notes and Memoranda—Miscellanea .. 355
Leading Articles—
Railways and Unfair Competition 357
The French Oil Problem 357
Institution of Mechanical Engineers 358
Literature 359
The Prague Fair 359
Kitson-Meyer Locomotive for Colombia. (Illus.) 360
Lubrication. (Illus.) 361
Pulverised Fuel. (Illus.) 362
A New Rectifier. (Illus.) 364
Books of Reference 364
Provincial Letters—
The Midlands and Staffordshire 364
Lancashire 365
Sheffield 366
North of England 366
Scotland 367
Wales and Adjoining Counties 367
Personal and Business Announcements 367
Contracts 367
Catalogues 367
Current Prices for Metals and Fuels 368
French Engineering Notes 369
British Patent Specifications. (Illus.) 369
Forthcoming Engagements 370

Two-page Supplement—Girardot Railway, Colombia, Kitson-Meyer Locomotive.

THE ENGINEER.

APRIL 1, 1927.

Railways and Unfair Competition.

It is not surprising that representatives of Capital and Labour, who are concerned for the prosperity of British railways, should have joined forces in order to approach the Chancellor of the Exchequer last week to protest against the unfair competition to which their industry is subjected. The main points upon which they were entitled to rely were duly emphasised by those who headed the deputation. Indeed, it was hardly necessary to state them: they are notorious. To set up in business the carrier by road requires no Bill in Parliament; no compulsory acquisition of land. He is confined to no particular route; he is not hampered in the matter of charges by the decrees of any Tribunal. He need provide no special facilities to meet the needs of the travelling public or of those who employ him to convey goods from place to place. Nor has he been the victim of legislation!

It is not too much to say that with the single exception of the Carriers Act, which was passed nearly a hundred years ago, those who carry goods by road are unhampered by any Act of Parliament. Subject to that Act—to which we shall refer presently—your carrier by road may carry what he likes, for whom he likes, may charge what he likes, and may carry subject to any conditions which he thinks fit to impose. Nor does the Carriers Act hamper the business of a carrier to any very alarming extent; indeed, it was passed in his interest, as well as in the interest of the public. And at best it only affects the person known to the law as a "common carrier." A "common carrier" is one who carries goods for all and sundry to or from any particular place or places. He may limit his business to certain classes of goods; but he is an insurer of everything which he carries, and as such is liable for all loss or damage, unless it be caused by the King's enemies or inherent vice in the thing itself, or by an "Act of God." The effect of the Carriers Act was to exempt him from liability for certain valuable articles carried in a parcel or package, and worth more than £10, unless declared by the consignor. The railway company is, in general, a common carrier, and as such is entitled to the protection of the Carriers Act, but a recent modification of that Act shows how the dice are loaded against the railways. By the Railways Act, 1921, the limit of £10 was increased, in the case of railway companies, to £25 as from "the appointed day." That day has not yet arrived; but when it does the railway company as a common carrier will be liable as insurers for the undeclared valuables specified in the Carriers Act up to £25, whereas the common carrier by road will continue to be protected if the value is greater than £10. So much for the common carrier; but it is probable that most of those who carry by road are special carriers who are not subjected to the heavy liabilities of a common carrier at all. They are only liable for negligence, and they can escape liability even for negligence by posting up notices in their receiving offices, or by any other means which bring home to the consignor the terms upon which his goods are to be conveyed. How different are the duties and liabilities of the railway companies! Ever since the middle of last century they have been under legislative control. Although they are not compelled to accept the full risks to which the common carrier is exposed—for they may declare that they are not common carriers of specific goods—they are bound to provide reasonable facilities (according to their powers) for the carriage of passengers and goods at reasonable rates. They must provide for the carriage of animals, and they cannot escape liability for negligence in the carriage of goods or animals except upon the terms of a contract which is reasonable and which must be signed by the consignor. All these duties and restrictions may have been properly imposed at a time when the railway company had no serious rival in the carrying trade; when it was necessary to protect the public against what might be, or become, abuse of a virtual monopoly. It would be too much to expect that they could be modified now. But when they find that their traffic is being captured by rivals who are under no such restrictions, is it any wonder that the railways are heard to complain?

It may be difficult, but it does not appear to us to be impossible to alleviate the situation. The Chancellor of the Exchequer may be able to do something, although he promised nothing. What the railway company really wants is a measure of relief from the burden of local rates to which it is often a large contributor, although it has no say in the election of those who levy the rate, and no voice in the councils of those who spend the money. Perhaps the best solution of the whole difficulty would be to grant special powers to every railway company to carry goods and passengers by road subject to all the terms and restrictions which obtain in relation to carriage along the permanent way. We venture to predict that with the knowledge and experience which is at their disposal they would soon provide facilities for traffic by road, which would be at least as advantageous to the public as those which are now furnished by a horde of independent carriers.

The French Oil Problem.

The failure to bring down the price of petrol in France at a time when everything pointed to a reduction has raised a strong feeling of antagonism to the operations of the five or six big importers who are known as the Oil Trust. The Government has for years past endeavoured to combat the Trust, and the question of making the importation of oils a State monopoly has been seriously considered, and is, in fact, not altogether abandoned, although it is recognised that to establish such a monopoly would entail financial obligations far too heavy to be incurred by the State. Nevertheless, the Government maintains its right to take action by limiting the period during which oils can be freely imported. That period has been extended another year, so that the oil companies are merely importing into France on sufferance, and the Government hopes to be able to elaborate a definite oil programme before the present period expires. The situation is regarded as extremely serious, for the reason that, except for a small quantity produced by Pechelbronn, in Alsace, France is dependent entirely upon foreign oil supplies, whilst the production of coal is barely sufficient to satisfy two-thirds of the home needs for solid fuel. Apart, therefore, from the necessity of sending huge sums of money out of the country for the purchase of solid and liquid fuels, it is obvious that in the event of hostilities France might find herself in a dilemma through being deprived of both coal and oil. The French consumption of oil is about 1,200,000 tons a year, nearly all of it imported refined, and the State is now endeavouring to solve the problem of reducing this importation by augmenting the production of oil in territories under French control. As it is quite impossible to produce enough oil to meet present requirements, it is intended to pursue a policy of reserving the French oil for national requirements, such as for naval and military purposes, and to supersede petrol for private use by home substitutes. Important interests have been acquired

in the oilfields of Poland and Roumania, which it is hoped eventually to develop fully with State aid. In Mesopotamia, also, France has a 25 per cent. participation. By making the most of these supplies, it is expected that she will become independent of foreign importations for the naval and military needs. The problem of supplying private requirements is being dealt with by the Office National des Combustibles Liquides, which has probably done as much research and experimental work as any similar body in other countries. In the organisation of practical tests it has certainly done much more. The results obtained are in many cases highly promising as indicating that it is possible to provide many substitutes for petrol, while the production of petrol and heavier oils by synthesis opens up a wide field, if only means can be found of obtaining sufficient quantities industrially at a low enough cost.

Unfortunately, the cost has until now invariably stood in the way of the practical use of petrol substitutes. Some years ago the French Government secured the passing of a Bill rendering compulsory the admixture of 10 per cent. alcohol with petrol. It was then discovered that the quantity of alcohol available was hopelessly insufficient, and the cost was too high. Technical missions are now at work in Africa investigating the means of distilling economically power alcohol from colonial products, such as agave, which are capable of growing, without attention, on land generally unsuited for other produce. The power alcohol problem, which is a purely economical one, has not been abandoned, and appears to be making slow progress towards the desired result of providing a cheap mixture with other hydro-carbons. The experience with benzol has been much the same as with alcohol, and after using different mixtures of alcohol, benzol and petrol for some years, the Paris Omnibus Company had to abandon benzol on account of the inadequate supplies. After trying every possible kind of fuel, the Paris motor omnibuses are now running on pure petrol, and a few are being operated experimentally with town gas carried in cylinders. So far as public service vehicles are concerned, the choice of fuel is largely guided by the necessity of avoiding anything which may cause inconvenience to passengers through noxious exhaust. The economic production of liquid fuels by distillation depends upon the available supplies of very cheap raw material. Even in the case of alcohol for mixing with petrol, the spirit has to undergo a further expensive process of dehydration before the mixture can be effected. All efforts now aim at providing an abundant supply of saccharine produce which can be distilled at low cost. French chemists have paid little attention to the hydrogenation of coal, on account of the high temperatures and pressures involved. They are concentrating their labours more particularly upon the synthetic production of fuels by the catalytic process. Notwithstanding the remarkable laboratory achievements of Professor Sabatier and Professor Maihle, that process has not yet entered upon an industrial stage, but it is believed to have approached it as the result of experiments made by Monsieur Audibert at the laboratory at Villiers-Saint-Paul, founded by the Société Nationale de Recherches, which body was created by the Office National des Combustibles Liquides, with the aid of the colliery companies. The catalytic phenomena are not sufficiently understood to allow of research being carried out along definite lines, and Monsieur Audibert therefore pursued his experiments upon the "trial and error" principle, until he discovered the exact nature of the catalysers required for the synthetical production of particular liquids. He found the catalyser for methyl alcohol, and its industrial possibilities appeared so good that the coalowners and others responsible for the Société Nationale de Recherches did not hesitate to provide the capital necessary for the laying down of an industrial plant near Lille, which is now nearly completed. So confident are they in the ultimate success of the efforts now being made to produce liquid fuels synthetically that the coalowners have constituted a company under the name of Carburants et Produits de Synthèse with a capital of 5,000,000f., which may be increased to 25,000,000f. The object of the company is to develop processes for the chemical treatment of coal and lignite and their by-products, not in the hope of securing immediate benefit, but with the idea that the problem of synthetical fuels can only be solved industrially with the aid of the particular groups of industries interested. If justified by results, other groups of industries will be invited to participate in the development work, and the new company may become eventually a national institution. The three research and development concerns which are carried on with the financial aid of the State and of the coal, chemical and other industries, are now making special efforts to provide new sources of liquid fuel supply by synthesis, low-temperature carbonisation and other means, and the Government hopes that the results obtained will enable it, at an early date, to modify the conditions under which oils can be imported, and to impose certain restrictions which will favour the development of home-produced fuels.

While the attempts to produce synthetical liquid fuels industrially from coke oven gases and from coal and other by-products have not yet reached a stage which can give promise of an assured success, the only really satisfactory outcome of the vast amount of research work carried out during the past few years is the application of gas producers to heavy vehicles. There is nothing doubtful about the working of suction gas. But has the drawback of lowering the efficiency of the petrol engine and the maintenance is more costly, while, to take advantage of the maximum power of the petrol engine, it is usually the practice to run the engine alternatively on suction gas and petrol, so that the spirit may be used when a special effort is required for ascending gradients. Under such conditions suction gas can have little chance of success unless it can be produced very cheaply, but the margin of fuel cost is wide enough to give an assured advantage to it if charcoal can be produced in sufficient quantities to meet the demand. Every effort is therefore now being made to develop the charcoal industry in a way that will not entail a destruction of woods and forests. It is hoped to produce the charcoal almost exclusively from brushwood, the supply of which is constantly renewed, but that is only possible with the aid of portable carbonising plants which can be carried wherever there is brushwood available. During the present month some further demonstrations are to be made near Blois with the carbonising of brushwood, the mechanical cutting and bundling of such wood, and the running of lorries and tractors with suction gas plants. If charcoal had to be employed in its ordinary form, it is doubtful whether it would meet with the approval of the majority of lorry users, but all objections to the handling of this fuel have been removed by the introduction of compressed charcoal under the name of carbonite. It is pressed into any desired form with an agglomerant which increases its calorific value. It is hard and clean, and is more convenient to handle than anthracite. It appears, therefore, that, so far as charcoal is concerned, the problem of a national fuel is in a fair way of being solved, and as soon as there is a certainty of sufficient supplies of cheap charcoal being available, it is the intention of the Office National des Combustibles Liquides to ask the Government to introduce a Bill rendering compulsory the use of that fuel for heavy vehicles. Meanwhile, trials and demonstrations are continually being made with a view of securing the fullest possible data concerning the running costs of vehicles employing petrol substitutes, and a number of cars and lorries using every kind of fuel, except petrol, are now making a tour of France. Their performances have been in all cases quite satisfactory. When this period of research and development is sufficiently advanced, the Government will possess all the needful data to enable it to settle definitely its future oil programme.

Institution of Mechanical Engineers.

On Friday evening of last week the Institution of Mechanical Engineers held a meeting in London jointly with the Chemical Engineering Group of the Society of Chemical Industry for the purpose of discussing a paper, entitled "Lubrication" by Dr. W. R. Ormandy. This paper, a reprint of which is begun elsewhere in this issue, presented an interesting summary of the present knowledge of the fundamental facts of lubrication and of the theories which have been built on those facts. The paper lost none of its interest by the manner in which Dr. Ormandy presented it, and in common, we think, with others, we felt considerable regret that the exigencies of the evening's arrangements cut short the time at the author's disposal for the introduction of his paper.

Mr. J. E. Southcombe, opening the discussion, remarked that lubrication was a popular subject, because it presented a study lying in the borderland of many sciences, including mechanics, physics, and chemistry. He was surprised to note that, according to Dr. Ormandy, the conception of "oiliness" in an oil was still vague, and that no means had yet been devised for its measurement. He (the speaker) held that oiliness was a very definite phenomenon, but that it was no more a specific property of oil *per se* than wetness was a property of water. Oiliness was a phenomenon manifested when solid surfaces met certain liquids or plastic fluids and was essentially a property of the interface. When one spoke of an "oily" oil, one meant an oil possessing to an extreme degree certain latent properties which when called into play at solid surfaces powerfully lowered their resistance to traction. Oiliness was a function both of the oil and the solid, as Deeley had originally pointed out. As regarded its measurement, the instrument devised by Deeley and the slider of Langmuir, Hardy and others appeared to measure oiliness with accuracy. The profound effect of free fatty acids in mineral oil in reducing the friction, entitled one to call such mixtures "oily" oils. Recent investigations had demonstrated that the property called oiliness was dependent upon a number of variables. According to P. Woog, there were four dominating factors, namely (1) adhesion of the molecules at the interface, resulting from residual affinity and orientation; (2) the dimensions and shape of the molecules; (3) the grouping or wedging of the molecules in the surface and adjacent layers; and (4) the molecular rigidity. Our views seemed fairly clear concerning the mechanism of the surface layer, but there remained unsettled the question as to what was the depth of the boundary film, and how far the field of force of the solid extended. In Dr. Stanton's experiments true fluid lubrication occurred with a film of the order of 10^{-5} cm. thick, but there were indications that at 10^{-4} cm. the solid field would manifest itself. Electrical methods did not seem applicable to the measurement of the thickness of such films. Had the author any information concerning the electrical properties of oils in very thin films? Were the ordinary laws for electric capacity actually obeyed? The author's observations on the influence of the solid surface were very interesting, and the high figure given for the coefficient of friction of phosphor bronze on steel—$\mu = 0{\cdot}510$—was very instructive in view of the fact that steel shafts running on phosphor bronze sometimes gave trouble.

Sir William B. Hardy supported Dr. Ormandy's insistence upon the fact that in investigating lubrication phenomena it was useless to work with unknown materials, and that a knowledge of their source and life history was essential, if fundamental results were to be obtained. It was necessary, Sir William said, to know the materials chemically, right up to the last atom. The results of his own investigations depended upon the fact that he had used critically pure materials. The essential variables that had to be taken into account in lubrication research introduced sufficient complexity without the additional complexity caused by the presence of chemical impurities. When the conditions were properly controlled, the laws revealed were of extraordinary simplicity when interpreted in terms of molecules, although they might be extremely difficult to interpret mathematically. For example, using lubricants of the paraffin series, and plotting the coefficient of friction against the number of carbon atoms in a molecule of the lubricant, he found that steel on steel gave a sloping straight line curve. With the same lubricants copper on copper gave an exactly parallel straight line curve, while copper on steel gave a third parallel line, exactly half-way between the first and second. These results, he emphasised, were obtained with chemically pure lubricants in pure air on critically clean surfaces. Continuing, Sir William described some results obtained in the course of an investigation into the relationship between adhesion and friction. A steel cylinder weighing 5·68 grammes, when allowed to "rest" on end on a clean flat steel surface, was found to be not in contact with the surface, but to be floating on a film of air about 0·007 mm. thick. The air was drawn in between the cylinder and the surface and served to support the cylinder. When palmitic acid was run between the two faces and the contact pressure was varied from 0·1 lb. to 250 lb. per square inch, it was found that the film thickness fell from 7 μ down almost to zero, and that the adhesion, that was to say the force required to lift the cylinder off the surface, steadily increased, both the curves showing a tendency to become asymptotic. Investigation of the structure of the layer between the cylinder and the surface showed that when it was of the order of about 5000 molecules thick, it consisted of a film attached to each of the steel faces with a definitely discontinuous crystalline film in between. If the substances used were chemically pure, the layer would break at both faces provided the cylinder and the surface were of the same metal. With the same lubricant, the adhesion to steel was greater than the adhesion to copper, and therefore if one of the members was made of copper instead of steel, the break would occur at the copper face and not at the steel face. It was found that the adhesion when one member was copper and the other steel was the arithmetic mean of the adhesion when both members were copper and the adhesion when both members were steel. That fact, he thought, defied any simple explanation. If the surface of the cylinder were merely contaminated with palmitic acid, and a chemically pure member of the paraffin series were used as the lubricant, the break occurred on the face not contaminated

with the acid, showing that the adhesion of acid was greater than the adhesion of paraffin. But it was remarkable to find that the adhesion on the uncontaminated face was less than it would have been if the other face had not been contaminated. That fact showed that the effect of the acid was exerted right throughout the thickness of the film of paraffin, a thickness of some 7000 molecules.

Dr. B. P. Haigh suggested that increased attention might be given to the influence of negative pressure, that was to say, the reverse of fluid pressure, on lubrication phenomena. In a lubricated journal the force between the axle and the bearing changed at one point from fluid pressure to fluid tension.* It was found that the resultant tension was less than the resultant pressure. At some point on the tension graph an interruption occurred. That interruption, in his view, was very important in any consideration of the theory of lubrication. He believed that in the tension region a cracking of the oil occurred with the liberation of carbon. Observations made during fatigue testing work led him to the opinion that oil broke up under mechanical stress, and that the blackening of a lubricating oil after it had been in use for some time was in large part the effect of the application to it of alternating stress and the consequent liberation of carbon. The limiting degree of stress which an oil could withstand without breaking up was, he thought, a matter demanding close attention.

Mr. A. G. Marshall, who, with Mr. C. H. Barton, is presenting to-night—Friday—a paper on lubricating oils at a second joint meeting of the Institution and the Chemical Engineering Group, said that his object would be to show the effect of changes in the "oiliness" of oils on the running of engines, and generally to discuss the relationship between laboratory and practical results.

Dr. H. E. Watson said that he had conducted experiments designed to measure the thickness of oil films by means of the dielectric constant method described by Dr. Ormandy. He found that liquid oleic acid or solid stearic acid when placed between a plate and a slider could not be made to conduct electricity at a pressure of 20,000 volts per millimetre of film thickness. Even in the liquid the slider could not be pressed right down into electrical contact with the plate.

Dr. H. S. Hele-Shaw said that that occasion was the first on which the engineer, the chemist and the physicist had met together to discuss what lubrication really was. Forty years ago the Institution of Mechanical Engineers had been responsible for Tower's most important investigation on lubrication. That research was, however, purely an engineer's investigation. Subsequent developments had brought the chemist and the physicist into the field to be covered. He suggested, as he had done five years ago, that the time had now come for another research on lubrication to include the co-operation of the engineer, the chemist, the physicist and the oil producer.

Dr. Ormandy, replying to Mr. Southcombe, said that he did not know whether thin films of oil showed the same dielectric constant as oil in bulk. Dealing with Dr. Haigh's remarks, he said that he would like to see the suggested breakdown by alternating stress substantiated by experiment designed to determine whether the blackening of oils was produced by the release of carbon from the lubricant or by the abrasion of the surfaces in contact.

Literature.

Collected Papers of Sir James Dewar. Edited by Lady Dewar, with the assistance of J. D. Hamilton Dickson, H. Munro Ross, and E. C. Scott Dickson. Cambridge University Press. 1927. Two volumes. £4 4s. net.

The first impression the reader receives upon opening these volumes is astonishment, the second disappointment, rapidly replaced by attraction. The astonishment is aroused by the fact that the titles of no less than 265 papers appear in the table of contents; the disappointment follows when it is found that many of the papers are not printed at all, and appear as "Titles only"; whilst of many others no more than abstracts or newspaper reports are given. Such disappointment is unreasonable, because it would, clearly, be impossible to print in less than many volumes all Dewar's papers in full; but it is, nevertheless, tantalising to find mere sketches of some things and of others references to other sources and nothing more.

Yet, taken as a whole, we have in these two stout volumes a mass of fascinating scientific literature that can only be equalled by a few similar productions. One is naturally tempted to compare Dewar with Faraday and Tyndall. He was first and last an experimenter. There is little or no abstract philosophy in all these papers. It was facts he wanted, and facts that he collected. One after another his papers record experiments and observations, as a rule with but little reflection upon the ulterior results of the phenomena described. We get an insight into Dewar's attitude of mind in his presidential address to the British Association in 1902, which we are glad to say is here reprinted in full. "We have to begin at the beginning," he said, "we have to train the population from the first to think correctly and logically, to deal at first hand with the facts, and to evolve, each one for himself, the solution of a problem put before him, instead of learning by rote the solution given by someone else. There are plenty of chemists turned out, even by our universities, who would be of no use to Bayer and Co. They are chockfull of formulæ, they can recite theories, and they know text-books by heart; but put them down to solve a new problem, freshly arisen in the laboratory, and you will find that their learning is all dead. It has not become a vital part of their mental equipment, and they are floored by the first emergence of the unexpected." If there was one thing that Dewar enjoyed it was dealing "at first hand with the facts," and we cannot doubt that the "first emergence of the unexpected" gave him real delight. He was in his element in the laboratory—not in the study. It is clear from all these papers that he wanted to be a-doing, and as we know he became one of the most notable researchers of his day and one of the most fascinating lecturers.

To the general as well as to the scientific public, his name is primarily associated with low-temperature investigations, and, secondly, with that beautiful study of thin films which he undertook towards the end of his life. But he was at first a chemist; many of his earlier papers deal with chemical subjects, and throughout his work his leaning towards chemistry can be seen. The first of his collected papers which gives some indication of the direction he was subsequently to take is No. 57, of 1878, "The Liquefaction of Gases." Some years passed before he comes back to the subject in Paper 121, of 1884, "On the Liquefaction of Oxygen and the Density of Liquid Hydrogen," which is condensed into a few lines in Vol. I., but from then on it makes frequent appearances—see Papers No. 122, 123, 125, 127, 148, 152, 154 (1893, "Liquid Atmospheric Air," a full paper, but short), 156 (1894, "Solidified Air," a mere note), 158 ("Scientific Uses of Liquid Air," a fairly full paper). Thereafter low-temperature research is the principal topic of the papers, until we come to those delightful studies which open with a wonderful paper on "The Problems of Capillarity" (1916), and are carried on by "Soap Bubbles of Long Duration," "Studies of Liquid Films," and others which were very familiar but a few years ago. Fortunately, many of these papers are given in full. They are "experimental" papers, reports of lectures at the Royal Institution, and so on, and are well illustrated. Apart from those on Liquid Air and other gases, they form by far the most attractive part of two very attractive volumes.

The work done by Lady Dewar and her assistants has been relatively small. They have faithfully collected all his papers as Dewar wished, but there is no attempt to edit them, there are no explanatory notes, no comments. That work has been left to some future hand. But as far as their work goes, the present editors have done it admirably, and the production of the book is above criticism. We may express a hope, however, that we have not seen the last of it. There is much in the volumes that is out of date, much that is of relatively little interest, much that could be omitted without serious loss, and a good deal that would benefit from the touch of a sympathetic editor. We should like to see all the papers on Low-temperature Research and all those on Films collected and produced at a price that would make them available to a larger public. We do not doubt that such a volume would make a wide appeal, for the subjects are interesting in themselves, and the experimental methods in which Dewar shone invariably exercise an attraction, even upon unscientific people.

The Prague Fair.

(*By our Continental Representative.*)

The Prague Fair, like that at Leipzig, is held twice yearly, following closely on the heels of the great German exhibition. Dating only from 1920 it has neither the antiquity nor the prestige of the latter, but with the energy of its youth it has already taken its place as an event of quite considerable commercial importance. Prague had long had the ambition of becoming the seat of an international fair, but under the policy of the old Austrian Empire no such rivalry with Vienna was permitted. It was only when, as a result of the war, Czecho-Slovakia became freed from Austrian domination, that the ambitions of the city could be realised. As soon as possible, a fair organisation, the efficiency of which has been demonstrated by the results of its efforts, was set up. The old Exhibition grounds, strongly reminiscent of our "White City," where the earlier Fairs were housed, soon became inadequate, and further accommodation had to be provided in temporary buildings on an adjoining site. Even so, there are numerous stands in the open air, which, both for the advantage of the exhibits and the comfort of visitors, might well be given protection from the weather. The success of the Fair, however, is now so assured that work has been begun on a series of fine permanent exhibition buildings close by, and the first of these, 140 m. long by 60 m. broad and 40 m. high, with seven exhibition floors and a total capacity of 250,000 cubic metres, will probably be ready next year.

The recent Fair, which opened on March 20th and closed on March 27th, comprised 2360 separate stands. Of these, about 20 per cent. were occupied by the products of foreign firms, for it is the policy of the authorities to render the Fair truly international, and to give foreign exhibitors every facility afforded to those of the country. What the word "international" implies in Eastern Europe may be gauged by the fact that the existence of the Fair was notified at Prague railway station in no less than nine European languages, and even then the Scandinavian and other important tongues were omitted. The catalogue was also compiled with the realisation that people who were not conversant with the language of the country would want to use it. The contents of the stands were indicated briefly in Czech, French and German, useful information was given in English as well, and English, French and German-speaking buyers could all find lists of exhibits arranged alphabetically in their own languages, together with a reference to the stands on which the various articles could be found. These lists contained something like 1700 names of articles, and the only criticism one could make was that the stands, on which the particular exhibits were to be found, were, in general vastly more numerous than the one or two usually indicated. In any case, however, the catalogue was very much superior to that issued by the Leipzig Fair authorities, who ignored any language but German, and it approached the excellence of the catalogue of the British Fair at Birmingham.

Moreover, the arrangement of the Fair also was as systematic as possible. Exhibits were grouped into twenty-five sections, those of a kind being in general collected together. Contrary to expectation, such products as glassware, ceramics, musical instruments and toys, which are often regarded as typical of Czecho-Slovakia, were by no means outstanding features of the Fair. The display of glass and china ware, indeed, was not nearly so impressive as that of the Czecho-Slovak section of the Leipzig Fair. Engineering was fairly well represented, a number of machine tools, wood-working machines and small tools being shown, but the largest sections of direct engineering interest were those devoted to agricultural machinery and motor bicycles. The Czecho-Slovak agricultural machine industry gives employment to some 40,000 men, and is largely dependent upon the export trade for its existence. It was noteworthy that some of the ploughs exhibited had the words "Made in Czecho-Slovakia" stencilled in English on their mould boards—an indication of the markets which absorb them. Much Czech agricultural machinery is now being exported to Russia, nine months' credit being given, and it is said that payments are made promptly when due, as further deliveries would otherwise be refused. We did not notice any British-built agricultural machinery at the Fair, though several of the better-known makes of American tractors were on view. The Americans, had, indeed, a special "Pavilion" of national products, amongst which typewriters, adding machines, and certain domestic articles were perhaps the most prominent. The American pavilion was organised by the efforts of the U.S.A. Commercial Attaché at Prague, and provided an excellent advertisement for American goods, much more effective than had the contents been distributed about the Fair, like the English goods, without special attention being called to their country of origin.

The section which was most gratifying to British national pride was certainly that devoted to motor cycles. The reputation which British motor cycles have obtained on the Continent is indicated by the fact that of the 4684 machines imported into Czecho-Slovakia during 1925, no less than 2632, or over 56 per cent., came from Great Britain. The United States followed with 964 machines and Germany came third with 704 machines. At the recent Fair we counted no less than twenty-three different British makes exhibited, and there may have been more. The staging of the motor cycle section was excellent, and business was further facilitated by an adjacent testing enclosure, where the behaviour of machines on the road could be demonstrated to prospective customers.

Another important and self-contained section of the Fair was that occupied by wireless apparatus. This, like the motor cycle section, was really an exhibition in itself. Two or three of the leading British manufacturers were represented, but the great majority of the eighty stands appeared to be occupied by apparatus of Czecho-Slovakian origin. The importance of publicity in relation to modern business was recognised by a special publicity exhibition held in a building by itself in the Fair grounds, and there several of the leading British newspapers and journals were represented, the stand of The Engineer occupying a prominent position.

* A cube of matter to all six faces of which pure tension was applied would be under fluid tension or negative pressure. Professor Haigh has made a study of the effects of negative pressure in connection with the theory of fatigue in metals.—Ed. The E.

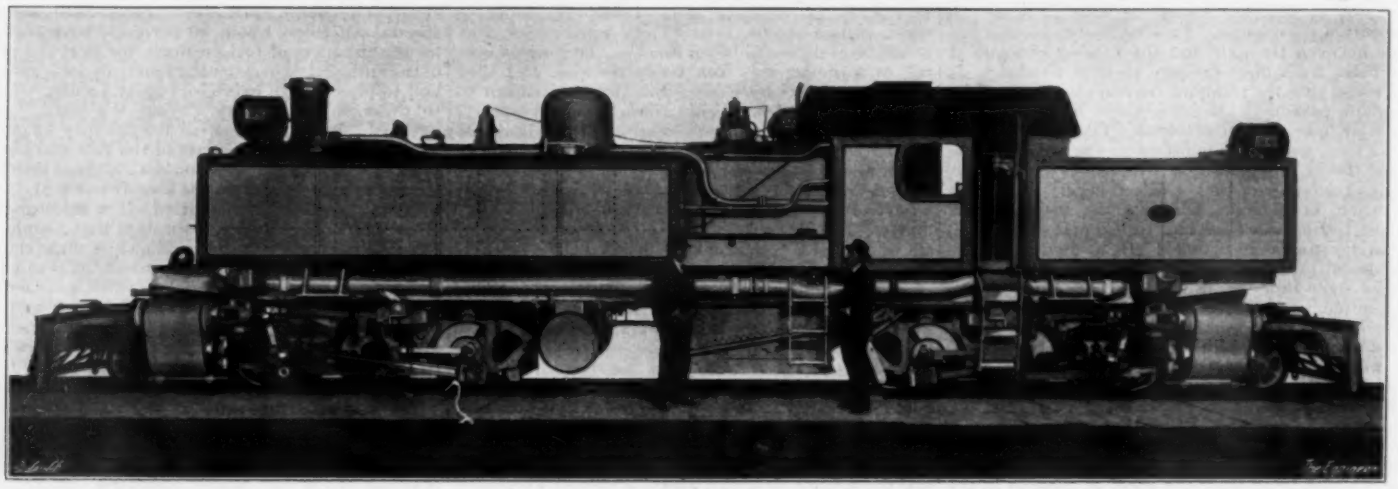
Kitson-Meyer Locomotive for Colombia.

WE illustrate on these pages and in a Supplement to-day an engine recently completed by Kitson and Co., Ltd., of Leeds, for Colombia, South America. This engine represents the latest developments of the Kitson-Meyer type, and was designed by Mr. P. C. Dewhurst, M.I. Mech. E., the Chief Mechanical Engineer of the Government of Colombia, for use on the Girardot Railway. On that line there are continuous gradients of 1 in 25, and almost continuous curves of almost 260ft. radius, with occasional instances of as much as 213ft. Although the design and specification are due to Mr. Dewhurst, and include all the special features which he has standardised for mountain railway locomotives, the constructional features follow the experience of the makers in this type of engine.

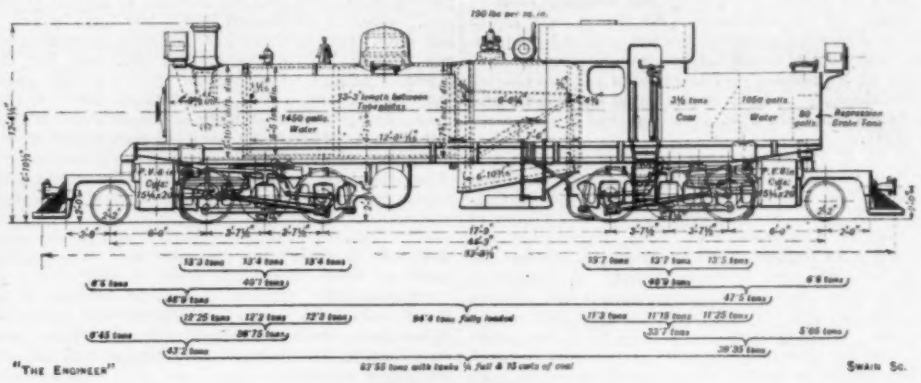
The compactness of the design is shown by the drawings, from which it will be seen that a reasonable length of wheel base has been obtained without sacrificing the inherent advantages of the Kitson-Meyer type. It will also be observed that bar framing is used for the motor bogies, and that it is placed outside the wheels. This bar framing was cut from solid rolled plate, the spaces being cut out by the oxy-coal-gas cutting apparatus. It will be noticed also that the water-carrying capacity is provided by side tanks placed well forward, and by a relatively large rear tank. Another feature to which attention may be directed is that the steam pipes run from the top of the superheater header back along the boiler barrel, to which they are closely lagged. The drawing below showing a cross section of a bogie illustrates clearly the relative situation of the outside framing, spring gear, tanks, &c., and together with the side elevation shows the accessibility of the various parts, notwithstanding the narrowness of the gauge and the large relative size of the locomotive. The cross section at the fire-box end shows the convenience provided for a straightforward fire-box. In order to secure the necessary curving properties of the engine, the pony trucks have three-point suspension hangers and the middle pair of coupled wheels of each bogie is flangeless, but 6½in. wide, whilst the other tires are 5½in. wide. All the coupled wheel springs of each bogie are equalised, and compensating levers connecting to the pony trucks are provided. The boiler is of a modified Belpaire pattern, the crown of the fire-box and the outer shell being curved—a necessity on locomotives for lines with considerable super-elevation of rails in order to obviate scorching of the fire-box crown. The material of the inside fire-box is mild steel; the crown-stays are also of the same material and have cup heads inside the fire-box. The tubes, after being expanded and beaded in the usual way, have their beads electrically welded to the fire-box tube plate. Two arch tubes are provided in the box.

The Colombian Government standards which have been adhered to in the design of the boiler, include the "Webb" fire-hole, with double sliding doors, rocking finger grates, "Pop" safety valves mounted 6in. above the boiler barrel, steam turret over fire-box in cab, injector top feed delivery, extra cleaning holes near front and back tube plates, mud door under barrel, removable smoke-box front, with small smoke-box door fastened by dogs, superheater joints of spherical-cone metal to metal pattern, spark arrester, ash ejector, &c. In the engine, Laird type crossheads and slide bars, piston-rods sufficiently long to allow the rings to be removed without disconnecting crosshead, union link connected direct to crosshead gudgeon pin, self-centring valve spindle guides integral with the steam chest covers, and other details of motions and rods are all in accord with Colombian standards.

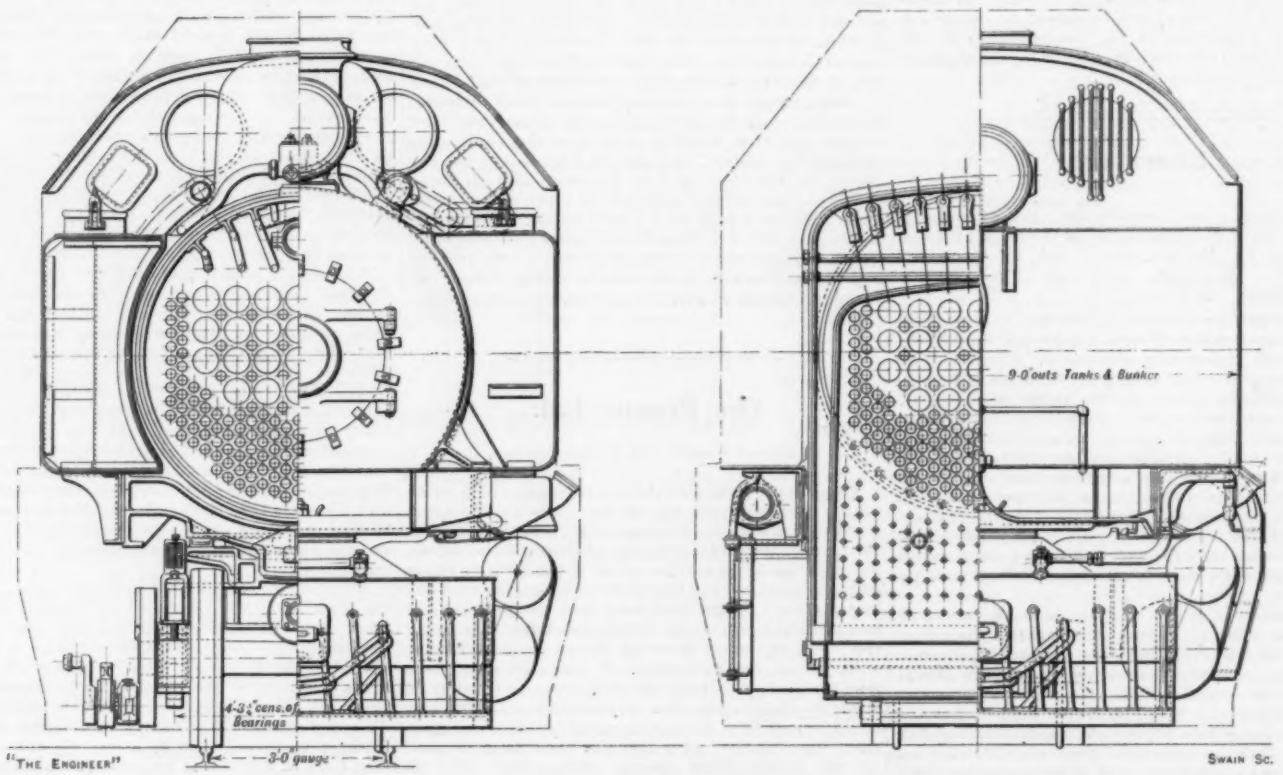
In regard to the radius rods of the valve motion, an interesting feature—due to Kitson and Co., Ltd.—is the



KITSON-MEYER 3-FOOT-GAUGE LOCOMOTIVE FOR THE GIRARDOT RAILWAY, COLOMBIA



WEIGHT DIAGRAM



END ELEVATIONS AND CROSS SECTIONS

tube plate. Two arch tubes are provided in the box.

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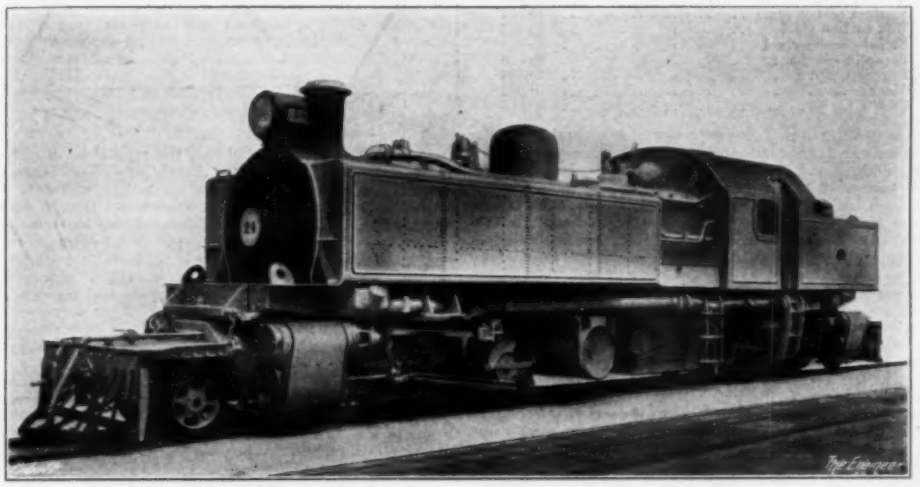
In regard to the radius rods of the valve motion, an interesting feature—due to Kitson and Co., Ltd.—is the

manner in which a good-length lifting link has been obtained, whilst keeping the reversing shaft very low, this object being attained by forming downward extending pieces on the forked parts of the radius rods. This feature will be clearly seen in the illustrations.

Amongst the subsidiary items may be mentioned the water level gauges, the upper (steam) connection to which is made from the fire-box shell on top to avoid the effect of surging of water against the back head sheet. The regulator is of the double-beat poppet type, with a "pull-out" handle, giving very sensitive adjustment in the admission of steam—very necessary on lines with frequently varying gradients and curves. The brake gear is arranged independently on each bogie, thus obviating any tendency to draw the bogies into a straight line when brakes are applied on curves. The electric generator is of 2½ K.W. capacity, and, in addition to the headlights and cab lights, provides illumination for a train of ten coaches. Lights are also fitted under the tanks on each side over the motion.

In addition to the diagram and the working drawings, a list of the principal dimensions other than those on the drawings is given. It shows also the principal ratios. In this connection we may refer to the high figure attained in the proportion of tractive force to weight of engine,



NARROW-GAUGE KITSON-MEYER LOCOMOTIVE

viz., 424 lb. per ton of total loaded weight, that of the fuel and water-carrying vehicle being included.

Government Railways of Colombia.—2-6-0 × 0-6-2 Kitson-Meyer Locomotives, Girardot Railway.

Conditions—	
Gauge	3ft.
Curves, minimum radius	213ft.
Gradient, maximum	1 in 25
Bridges (Coopers E.)	"E-40"
Rails, per yard	60 lb.
Principal dimensions, additional to diagram—	
Engine—	
Cylinders, four	15½in. × 20in.
Piston valves, diameter	8in.
Wheels, diameter of pony	2ft. 2in.
" " driving and coupled	3ft. 1½in.
Wheel base, adhesive, each bogie	7ft. 3in.
" total, each bogie	13ft. 3in.
" total, engine	44ft. 3in.
Fire-box shell, width	5ft. 11½in.
Grate, length	0ft. 9½in.
" width	5ft. 3½in.
Flues, number and outside diameter	26, 5½in.
Tubes, " " "	166, 2in.
Superheater tubes, number and outside diameter	104, 1¾in.
Heating surface, tubes and flues	1636·5 sq. ft.
" " fire-box	155 sq. ft.
" " arch tubes, 3in. diam.	11 sq. ft.
" " total evaporative	1802·5 sq. ft.
Superheater surface	380 sq. ft.
Equiv. H.S. = total evap. H.S. + 1·33 superheater surface	= 2309 sq. ft.
Grate area	35·5 sq. ft.
Boiler pressure, per sq. in.	190 lb.
Water capacity	2500 galls. (Br.).
Fuel capacity	3½ tons coal
Tractive force—	
Rated tractive force—	
At 85 per cent. boiler pressure	40,000 lb.
At 75 " "	35,294 lb.
Tractive force (at 85 per cent.) per ton of engine weight	424 lb.
Ratios—	
Adhesion weight (fully loaded) / Tractive force (at 85 per cent. B.P.)	4·53
Rated tractive force (at 85 per cent.) / Equivalent heating surface	17·3
Total evaporative surface / Grate area	65·0
Total evaporative surface / Superheating surface	4·7

THE INSTITUTION OF MINING AND METALLURGY.—The Council of the Institution of Mining and Metallurgy has made the following awards:—The Gold Medal of the Institution to Emeritus Professor William Frecheville, A.R.S.M., Hon. M. Inst. M.M., in recognition of his services to the mining industry during a long and distinguished professional career, and to mining engineering education; "The Consolidated Gold Fields of South Africa, Ltd." Gold Medal and Premium of Forty Guineas to Dr. Sydney W. Smith, A.R.S.M., M. Inst. M.M., for his paper, embodying much original research, on "Liquation in Molten Alloys and its Possible Geological Significance"; and the "Arthur Claudet" Student's Prize of Ten Guineas to Mr. Robert A. Mackay, A.R.S.M., Stud. Inst. M.M., for a paper on "The Influence of Superimposed Strata on the Deposition of Certain Lead-Zinc Ores."

Lubrication.*

By W. R. ORMANDY, D.Sc., F.I.C.

THE author has thought it well to deal in the commencement with the bearing of some of the new discoveries relating to the chemistry of the atom and the molecule on the problem of lubrication. The word "liquid" is a term which conveys a general idea to the mind, but one does not usually consider the wonderful and complicated happenings on the surface of a liquid or their bearing upon the practical problems of the day; and still less easily does one realise that the apparently inert surface of a solid may be the home of great and important forces. Yet lubrication is essentially the problem of liquid and solid interfaces. It is the author's desire in the immediately following remarks to consider briefly the interfaces formed by contact of a bulk liquid with gaseous, liquid, and solid faces and the properties of the solid gas or liquid interface.

A liquid tends to take up its minimum surface, and the action is as though the surface of the liquid were covered with an elastic skin. It is obvious that molecules in the bulk of the liquid are attracted more or less equally in all directions, but that a molecule in the surface is being pulled back by the attraction of a hemisphere of molecules surrounding and below it. It has been argued that the amount of work necessary to bring all the molecules of a bulk of liquid into the surface layer will be one-half the latent heat of evaporation of the liquid, and in the case of molecules having no particularly pronounced chemical attraction in any direction, *i.e.*, non-polar molecules, this is approximately the case; but if the molecules have chemically active groups at one end, such as the acids and alcohols, another possibility has to be considered. If we imagine such a polar molecule reaching the surface and so orientated that the inert portion of the molecule points outwards and the polar part is, as it were, rooted into the bulk of the liquid, then it seems likely that the work done in tearing away such a molecule from the surface should be greater than the amount necessary to bring it into the surface. It is true that we have here to make an assumption, namely, that the period of time during which such a molecule is in the surface is long in comparison with the natural period of the molecule, but this seems justified. In the case of water at 20 deg. Cent. some 10^{23} molecules leave and come back to each square centimetre of surface in a second, which is equivalent to saying that the life of a molecule on the surface is 10^{-7} second; whereas the natural period of the molecule is of the order of 10^{-13} second, which leaves time for some degree of orientation. An examination of the surface energy and latent heats of evaporation for a series of compounds at corresponding temperatures made by Harkins and Robert bears out this contention. The symmetrical molecule carbon-tetrachloride gives a ratio between the two quantities of 0·452, whereas ethyl-alcohol gives a ratio of 0·186. The results obtained by work on the surface energy and the latent heats of evaporation as well as upon the influence of temperature upon the surface tension of liquids point to the fact that the surface layer is largely influenced by the shape of the molecule and the presence in it of polar groups.

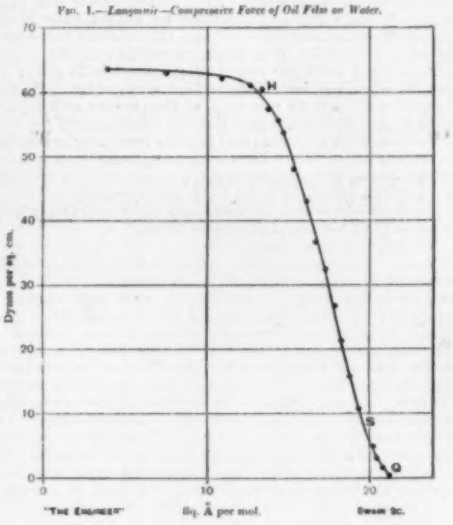
Uni-molecular Character of Surface Films.—Langmuir produced extraordinarily thin films of solids on the surface of water by dissolving solids such as palmitic acid in ether, pouring them on to the water surface and allowing the ether to evaporate. By this means he was able to calculate what weight of the acid covered a given area, and he devised apparatus for measuring the surface tension of the film in comparison with the surface tension of water.

The least pressure applied to the film was that necessary to keep it from spreading out indefinitely. In Fig. 1 the point Q marks the lowest measured compression, giving the molecular area of 21·8 A, and at this point the film of palmitic acid is a mobile liquid. With increasing pressure at the point S the surface has become solid, and from S to H the diminution in area is much the same as would be experienced by palmitic acid in bulk subjected to the same relative degree of pressure. At H the surface begins to give way and crinkle.

From these experiments he was able to calculate the cross section of the molecules and also to estimate the length of the molecule. The fatty acids occupied practically the same area, but their chains varied in length. The glycerides occupy three times the area of the acids from which they are derived. As the distance calculated between the carbon atoms was less than that found between adjacent carbon atoms in the diamond, namely, 1·5 A, it is suggested that in the long-chain compounds the carbon atoms are either zig-zag or spirally arranged. This is the first point which has direct relationship to the lubrication problem, for if there are forces on the surface of a metal like the forces on the surface of a water layer, then polar bodies might be expected to take up orientated positions on the metals. As the length of the chain increases and there is attraction between the chains the space occupied by the polar head becomes less.

The work which has to be done to separate one portion of a liquid from another portion of the same liquid or to separate one liquid from another liquid is of great interest. To separate a bar of water one square centimetre in section requires 14·8 ergs; for octane 43·5 ergs are required; for octane and water 43·8 ergs; for octyl-alcohol 55·1; and for octyl-alcohol-water 91·8. Harkins considers that when a bar of octyl-alcohol is broken the molecules on each side of the break orientate themselves so that the final break occurs between the ends of the hydrocarbon chains, that is, in the position which incurs the least possible expenditure of work; but in that case the octyl-alcohol

FIG. 1.—*Langmuir—Compressive Force of Oil Film on Water.*



breakage should be practically the same as that obtained on the breakage of octane. The experimental difference is attributed to lack of perfect orientation, but it is correct in degree. When octyl-alcohol is separated from water the hydroxyl groups of the alcohol tend to stick in the water, and we should expect to find the high value for the work of adhesion.

Surface Energy of Solids.—Enough has been said to show that very considerable forces are in action at the interfaces of liquids and that the chemical constitution of the molecules in question is all important in determining the eventual arrangement at the interface. The fact is perhaps not so widely known that solid surfaces exhibit similar properties and often in an even higher degree. It is generally known that charcoal has the power of adsorbing many gases and colouring materials from liquids. The most common form of solid material is that known as crystalline, and that crystal faces exert powers outside their own boundary is very beautifully shown by the experiment of Sir George Beilby, whereby he demonstrated that the face of a calcspar crystal could cause an isomorphous material, sodium nitrate, to crystallise in such a way that the crystals grew in regular orientation to the calcspar surface.

It has long been suspected that the atoms in a crystal are regularly disposed, and this was demonstrated even more forcibly by application of X-ray analysis. As the attraction between the atoms in the crystal is electrical or electro-magnetic, those atoms which are in the crystal face have fields of energy immediately above the face, and it would be expected that atoms placed at the edges of crystals would exert greater external action than those in the middle of a face. Continuing this argument, one would expect that a micro-crystalline or amorphous material would exert greater action externally than would the centre of a crystalline face, and this is borne out in practice. We know that freshly split pieces of mica adhere perfectly with comparatively slight pressure, that clean platinum faces weld far below the melting temperature of platinum, and that optically polished glass faces also weld together. All of these facts are evidences of the existence of these external fields of force. The actual energy of crystal faces varies in some way with the closeness of the packing of the atoms in the particular face and the distance from the next face. It has been estimated that in the case of common salt the energy may vary from one crystal face to another in the ratio of 1 to 4. Not only is the surface energy different in the crystal face and at corners and edges, not only is it affected by the closeness of the packing in the face in question, but it may be materially affected by the presence of admixture of other solids. Such other solids added to a body which is causing a catalytic reaction are termed promoters. That metallic surfaces specially prepared for catalytic purposes are not equally active over all is shown by carrying out experiments wherein traces of poisonous materials which inhibit the reaction are gradually admitted. It has been found that the quantity of poison which is only capable of giving a mono-molecular layer on a mere fraction of the total catalytic surface will prohibit some reactions, though it may permit of other reactions being brought about which are in turn prevented by the introduction of further quantities of the poisoning material. Whereas on water insoluble fatty acids were shown with a high degree of probability to form mono-molecular layers, it seems equally probable that gases and vapours can be adsorbed on to a solid surface in layers many molecules thick, and Hardy's work on

* Joint meeting of the Institution of Mechanical Engineers with the Society of Chemical Industry (Chemical Engineering Group).

lubrication, which will be referred to later, bears this out. Whether it be that in the case of metals the external field is strong enough to be appreciable at several molecular diameters or whether the mutual action between the layers is in some way induced (like rows of filings on a magnet) can hardly be regarded as settled, but certainly the energy with which these second and further layers are held in position is very small compared with the energy with which the first layer is held.

It becomes a question of interest to know whether polar bodies would be orientated on solids in the same way as they undoubtedly are on water. The X-ray work of Shearer shows that this is undoubtedly the case with the fatty acids on mica. Bodies having no polar groups such as saturated hydrocarbons (highly refined lubricating oils) are undoubtedly adsorbed on most solid surfaces, but on metals they are exceedingly easily displaced by alcohols or fatty acids having strong polar groups, as was shown by Hardy. An experiment of an entirely different type is the conversion of alcohols into aldehydes. Whether ethyl-alcohol CH_3CH_2OH or alcohols having many additional CH_2 groups in the chain be employed, it is found that the temperature coefficient of the reaction is identical, from which we may gather that it is the common polar group CH_2OH which is attracted to the copper catalyst in every case. If hydrogen and ethylene be passed over heated copper the gases are adsorbed and the reaction takes place between them, but if a small proportion of the copper surface (only 0·01 per cent.) be poisoned both gases will still be adsorbed, but there will be no reaction. Further poisoning of, say, 40 per cent. of the surface will prevent the adsorption of hydrogen, but the remaining 60 per cent. will still adsorb ethylene, and further poisoning is required to prevent this. It is believed that the small portion which brings about the actual reaction is amorphous, and that the portion which adsorbs both gases consists of micro-crystalline edges and corners, and the remaining portion is considered to consist of crystal faces.

All solid surfaces have sufficient free energy to cause them to adsorb either gases or liquids with great intensity. Some solids such as glass adsorb the constituents of the air and are not wetted by mercury. A very high vacuum is necessary to cause the removal of these adsorbed gases before mercury can be made to wet a glass surface. A steel bar can only be caused to amalgamate with mercury if the bar be broken under mercury, as otherwise an adsorbed gas film is formed which prevents a true metallic contact. Liquids of low surface tension are more likely to wet solids than liquids of high surface tension. Oils which have a low surface tension will wet most solid surfaces, whilst water wets a limited variety of surfaces. This is made the basis of the ore flotation process, which has opened up to possible use millions of tons of low-grade ores which were previously unusable. The oils employed displace the water from the surface of the metallic sulphides, but the water displaces the oil from the surface of the powdered gangue.

Methylene blue is adsorbed on diamond but not on graphite, and succinic acid is adsorbed on graphite and not on diamond. Ball clay adsorbs caustic soda and also adsorbs phenol-phthalein without bringing about any change in colour, so that it would appear that different parts of the clay surface adsorb the various molecules. Gurtvich pointed out that bodies such as Fuller's earth, charcoals, bauxite and the like adsorb unsaturated bodies more readily than saturated ones, and that the heat which is generated on such adsorption is in some degree a measure of the saturation of the bodies adsorbed.

Soap films consist of double layers of orientated molecules with some water between, and as the inactive part of the molecules is on the outside of the film such films slide easily over each other and lead to the formation of the prismatic coloration.

The work of Shearer and others has gone far towards enabling us to fix the dimensions of the rectangular base of a molecular cell, as well as to measure the length of the molecule.

The work of Müller and Shearer has shown that some compounds have double molecules per unit, and a helical arrangement for the carbon atom in the long chain has been suggested, similar to the spiral arrangement of silica in quartz.

Spreading on Solid Surfaces.—The spreading of fatty acids and higher alcohols on a water layer is aided by the thermal agitation, and is also due probably to the solvation of the polar part of the molecule, but on solids such actions cannot take place. On a clean metallic surface spreading does not take place, but it will occur, as Hardy has shown, if the metallic surface is wetted in the first place. With liquids having an appreciable vapour tension the wetting of the metallic surface occurs by evaporation and condensation.

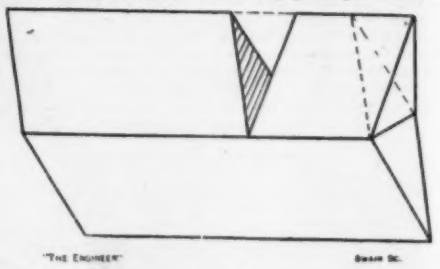
Work of Hardy.—Hardy and his co-workers have shown that if very thin layers of non-polar bodies are formed on optically true surfaces which are afterwards brought into contact, such surfaces show a minimum coefficient of friction immediately, whereas when polar bodies are similarly employed there is a considerable time lag before the equilibrium state of minimum friction is attained. This is explained by the suggestion that in the case of the polar bodies considerable time is necessary for the long rod-like molecules to sort themselves out in such wise that the polar end is on the metal faces, so that the friction takes place eventually at the meeting point and between the non-polar ends. Where a non-polar oil is mixed with small amounts of polar oil there is a lag, but of much shorter duration, since it is easier in this case for the polar-end molecules to get into the desired position. Another very interesting observation of the same workers is the length of time which even the comparatively small plane surface takes to squeeze out the excess of intervening oil and to reach an equilibrium position. When the metallic surfaces are placed in contact and the oil is allowed to penetrate between them equilibrium is very rapidly reached, and in the latter case the equilibrium obtaining is that which would be reached after a great length of time had an excess of oil been originally placed between the plates. In other words, the oil between the plates, even when of a thickness of many molecules, behaves as though it possessed a much higher viscosity than attaches to the oil in bulk. It is also interesting to note that the frictional resistance when the final steady state has been attained is independent of the temperature; but, on the other hand, the time required to reach a state of equilibrium, that is, the duration of the latent period, is much reduced either by mechanical agitation or by increase in temperature. When a mixture of polar and non-polar lubricants is employed, so long as there is more than about 0·7 per cent. of the polar body the friction is of the order of that of the polar body alone. This point is of great practical value, and it is this which is referred to in the practical work of Southcombe on the production of commercial lubricating oils consisting largely of non-polar products mixed with small quantities of polar bodies, such as oleic acid. Hardy has further shown that the coefficient of friction between the plane faces decreases as the load increases up to a certain pressure, beyond which the coefficient is independent of the load, and he draws the conclusion that during the first period the slider is floating on a layer of lubricant whose thickness is a function of the pressure, whilst in the second period a layer of molecular composition has been reached; and he adds that in the first period the friction is adjusted to the load by variations in the thickness of the layer of lubricant, and in the second period by the elastic forces between the atoms. It becomes a question of great interest as to how far the nature of the solid frictional surfaces influences the coefficient of friction. Using a steel slider with a plane face comparatively lightly loaded and using octyl-alcohol as a lubricant, the following values for the coefficient of friction were obtained :—

Plate.	μ
Medium carbon steel	0·463
Mild carbon steel	0·457
Nickel-chrome steel	0·469
Phosphor-bronze	0·510
Bismuth	0·438
Glass	0·523
Quartz	0·472

We are dealing in this case with layers of several molecular thicknesses. If the fields of force on the plane solid surfaces were holding one layer of molecules firmly, and these in their turn were holding a second layer, and these a third, and so on, like filings on a magnet, then whatever the nature of the metal one would expect the coefficient of friction to be similar in all cases for one liquid, for assuming six molecular layers it would be a measure of the energy necessary to slide the non-polar ends of the third layers over each other, whereas in fact quite appreciable differences are observed.

In his studies in adhesion Hardy has experimented upon the force necessary to pull apart plane solid surfaces when these are separated from one another by liquid layers. Whether the load was allowed to sink for a great length of time, or whether the fluid was allowed to enter between the plane surfaces by capillary action, so that what is known as the Leslie layer was formed, the results were the same; but the time necessary for the liquid to penetrate by capillarity and that necessary to expel the excess by the weight of the cylinder varied so enormously that he likens the difference in the two cases to that between drawing in a light spirit and expressing a jelly. As the Leslie layer may be hundreds or thousands of molecules in thickness, Hardy argues that the difference in behaviour in the two cases is in some way brought about by the fields of force of the solid faces acting through astonishingly great distances. Here again the latent period makes itself evident when polar liquids and only when polar liquids are allowed to penetrate between the plane surfaces, due probably to the time necessary for proper orientation. In these experiments also the nature of the solid employed is of great importance, for the adhesion, using any one liquid, was always greatest with glass, less with steel, and still less with copper. So great is this effect that Hardy points to its possible influence in certain types of viscosimeters. It is interesting to note that irregular flow and eventual clogging have been observed with certain oils and iron or steel capillary tubes. If two thoroughly clean, plane metallic surfaces be brought into contact seizure occurs if an attempt be made to move the faces tangentially. Two such surfaces in contact will still offer a great resistance to tangential movement even if a lubricant having a very low vapour pressure, such as oleic acid, be brought into contact with the edges of the plates; but the mere presence of the vapour of a polar liquid having an appreciable vapour pressure will cause the plates to slide over each other with little effort, the time necessary for this release being a function of the volatility of the lubricating vapour employed. Hardy has pointed out that when using a spherical slider on a plane surface using solid lubricant such as stearic acid, the coefficient of friction remains practically the same whether the experiments be carried out above or below the melting point of the stearic acid. The coefficient of friction found when the slider is first drawn across the solid lubricant is lower than that obtained when the slider has been moved a few times backwards and forward. He assumes that a natural plane of cleavage exists in the solid lubricant. He says that whether this plane is a surface of discontinuity between these molecules, orientated by the attraction field of the solid and the crystal lattice of the mass, or whether it is defined merely as a critical capacity for withstanding attraction, must be left uncertain. It is interesting to recall the little-known fact that in certain comparatively hard crystals sliding planes exist in some cases in a very pronounced degree. Thus artificial twins can be made from rhombohedral crystals of calcspar by merely pressing a knife on to the correctly chosen edge of the crystal, as shown in Fig. 2. In a length of 1 cm. of such a crystal something like 10^8 molecular layers have slipped over each other into a new position of equilibrium, and yet the whole substance of the crystal is optically unstrained.

Fig. 2—*Artificially produced Twinning of Calcspar Rhomb.*



The author hopes that in the foregoing enough has been said to show that the problem of lubrication is not merely a question of pressure, time and viscosity, but that very many of the chemical and physical properties of the metals of which the bearings are made, as well of the fluids employed, play important parts.

(To be continued).

Pulverised Fuel.

A paper on Pulverised Fuel was recently read before the North-Western Branch of the Institution of Mechanical Engineers, by Mr. R. B. Potter. Mr. C. Bentham, chairman of the branch, presided, and there was a very large attendance of members and visitors. The paper was illustrated by lantern slides.

The author opened his subject with some general remarks, in which he referred to the advantages of powdered fuel, its increased efficiency and flexibility, the possibility of using any class of fuel and the better labour and smoke conditions. He dealt with the apparatus in two sections—(1) that for the preparation of the fuel and (2) that for the combustion. With regard to the apparatus for preparation, it was, he said, subdivisible into two headings, the central and the unit systems, the outstanding difference being that, in the former, coal was stored in the pulverised state, whereas with the latter it was burnt

FIG. 1—TABLE TYPE CONTROLLERS FOR PULVERISED FUEL

as soon as it was pulverised. There was a useful sphere for both systems. The central system was the more costly, but obtained an advantage from the lower power consumption per ton, and was thus better suited for large stations. The special plant needed for the central system included dryers, pulverisers, transport arrangements and feeders or burners. In comparing the two systems of pulverising, namely, the ball and the roller mills, the author said that as regarded freedom from breakdowns the ball mill had proved the more reliable. With roller mills the chief trouble was due to the system of internal lubrication.

The means of transport of the pulverised fuel from the point of preparation to the point of usage were described. The circulating system consisted in the continuous circulation of a mixture of coal dust and air in a large circular main with small offtakes to each point of usage, at which a secondary supply of air was provided. The mixture in the main was not explosive, but a small inleak of air would make it so, and if for any reason the pressure in the main dropped, there was the possibility of an explosion occurring. In many cases where the pulverisers could be situated in the boiler-house or adjacent to it, it was found economical to fit more powerful fans to the pulveriser air circuits and deliver direct to "cyclones" stationed above the pulverised coal bins at the boilers. In such cases it was customary to fit screw conveyors below the cyclones, so that any pulveriser could feed to any bin.

If the pulveriser-house was at some distance from the boiler-house, pulverised coal bunkers must be put in the former as well as the bins at the boilers, and the means of transport could be screw conveyors, compressed air, or a combination of these two. In the case of compressed air delivery, the coal was blown from reservoirs through small diameter pipes to cyclones delivering into bins at the boilers. The pressure needed varied with the distance to be travelled, i.e., from 25 lb. to 45 lb. per square inch. The author mentioned one such installation in France, where the distance between the pulveriser-house and the

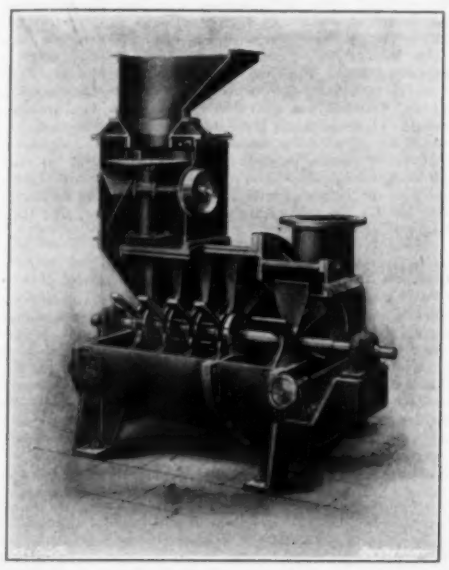


FIG. 2—BEATER TYPE PULVERISING UNIT

boilers was 700 yards, and the rate of transmission through a 4in. pipe over a ton per minute.

Under the heading "Feeders and Burners," the author said that the feeders were generally of the screw or table type, and in either case it was usual to provide one feeder for each burner to give accurate regulation of the fuel. The usual screw feeder consisted essentially of a cast iron screw of varying pitch, rotating in a trough into which the pulverised coal flowed by gravity. The coal was propelled forward by the rotation of the screw to a shrouded end, at the outlet from which it met air introduced under pressure from the primary air fan, and was mixed therewith by a paddle fixed on the end of the screw shaft. Regulation of the feed was made by varying the speed of the driving motor, which was arranged to drive a whole group of feeders. Clutches were provided for throwing one or more feeders out of commission. The table type controller consisted of a disc with a number of holes in it, which rotated between two fixed plates—see Fig. 1. The upper plate had a port in it, which communicated directly with the coal supply and the lower plate a discharge outlet. As each hole in the middle disc came under the feed opening, it was filled with coal, which was carried round to the discharge outlet, whence it fell by gravity. An adjustable slide on the outlet regulated the amount of coal which could escape, and when the port came underneath the feed opening it was refilled completely. The controllers were driven by belt and countershafting from the primary air fan, which could be a constant speed machine, thus obviating any expensive variable speed mechansim. The coal from the outlet of the controller fell by gravity into a funnel-shaped vertical pipe entering the primary air main. The flow of coal could thus be actually seen entering the funnel, and samples could be taken, while some of the primary air was induced through the funnel to prevent any possibility of coal dust escaping into the atmosphere.

In all systems the primary air was used merely as a carrying medium for the coal, and usually amounted to about 15 per cent. of that necessary for combustion. The secondary air was not met till the fuel reached the burner, or in some cases the combustion chamber.

The unit system combined all the functions of pulverisers, transporters and fans in each machine. In most cases dryers were not used, since there was no storage of pulverised coal as such, but in certain cases where the coal to be used was very small, and/or of a high clay content, capable of retaining as much as 20 per cent. moisture, dryers were installed. Complete drying—i.e., down to 1½ per cent.—was not essential, so that the bulky and expensive horizontally inclined dryer was usually discarded in favour of the cheaper steam dryer. The number of different types of units on the market, said the author, was very great, but they were mostly of the beater type, either fixed or swing hammers being used—see Fig. 2. In other types the grinding was effected by a series of projecting studs on a rotor which meshed between other studs on a stator. The chief points in which the various units differed were the type of feed employed, methods of air separation, magnetic separators or some mechanical means for extracting tramp iron, and air regulation.

Units were moderately high-speed machines, 1450 r.p.m. being a common speed. That was necessitated by the need for incorporating a fan as well as by considerations of space. Under those circumstances, the wear on the grinding parts was liable to be heavy, and attention should be paid to that aspect when deciding on which type to install. The maintenance costs on various units varied considerably, some running as high as 1s. per ton, others much lower. One station engineer after three years' experience informed the author that he had reduced his maintenance costs to the surprising figure of 0·8d. per ton. These costs naturally varied considerably, according to the class of coal used and its moisture content. Other points to be considered were power consumption, accessibility, bearings—which should always be external—and fineness of pulverisation.

Where moderately dry coal could be employed, the unit system could compete with any other method of firing, for all except the very largest plants. Its capital cost was comparable to that of chain grate stokers for a given output, and it was of especial importance in enabling tests to be run before a larger plant was decided upon.

The burning of pulverised fuel was a much more complicated question than that of pulverising, and, though the actual combustion offered few difficulties, it was safe to say that, had the attendant problems been satisfactorily solved earlier in the century, pulverised coal firing would be almost universal to-day for all large stations.

The author said it was probable that the boilers of 1937 would be entirely dissimilar from those in common use now, although the latter had changed only in detail from those of pre-war days. There were two designs at present on the market of peculiar interest, the radiation boiler—one of which was working in Trafford Park, while two more were under construction at Brighton—and the new boilers which were nearing completion at Birmingham. The former boiler was the most radical departure from old practice, as all the steam generating elements were grouped round the combustion space. The four walls were formed of fin tubes expanded top and bottom into drums, and the floor was formed of a water screen. The gases left the furnace at the bottom and passed through a separate superheater and air heater. The published information about its performance was conspicuous by its absence, but the author understood that a very high efficiency was claimed for it. The pressure was 260 lb. per square inch, and the steam temperature as delivered 825 deg. Fah., while the air was preheated to about 615 deg. Fah. The chief difficulty would appear to be to obtain a sufficiently low exit gas temperature.

The new boilers at Birmingham—one of which is shown in section in Fig. 3—were more remarkable for their size than for revolutionary design, since each was rated to evaporate a maximum of 100,000 lb. of water per hour at a pressure of 320 lb. per square inch. Each boiler was composed of two tri-drum boilers set face to face with a large combustion chamber formed between and underneath. Each wall—as well as the roof and bottom slopes—was cooled by water tubes expanded into headers or drums, but all the tubes, except the roof tubes, were

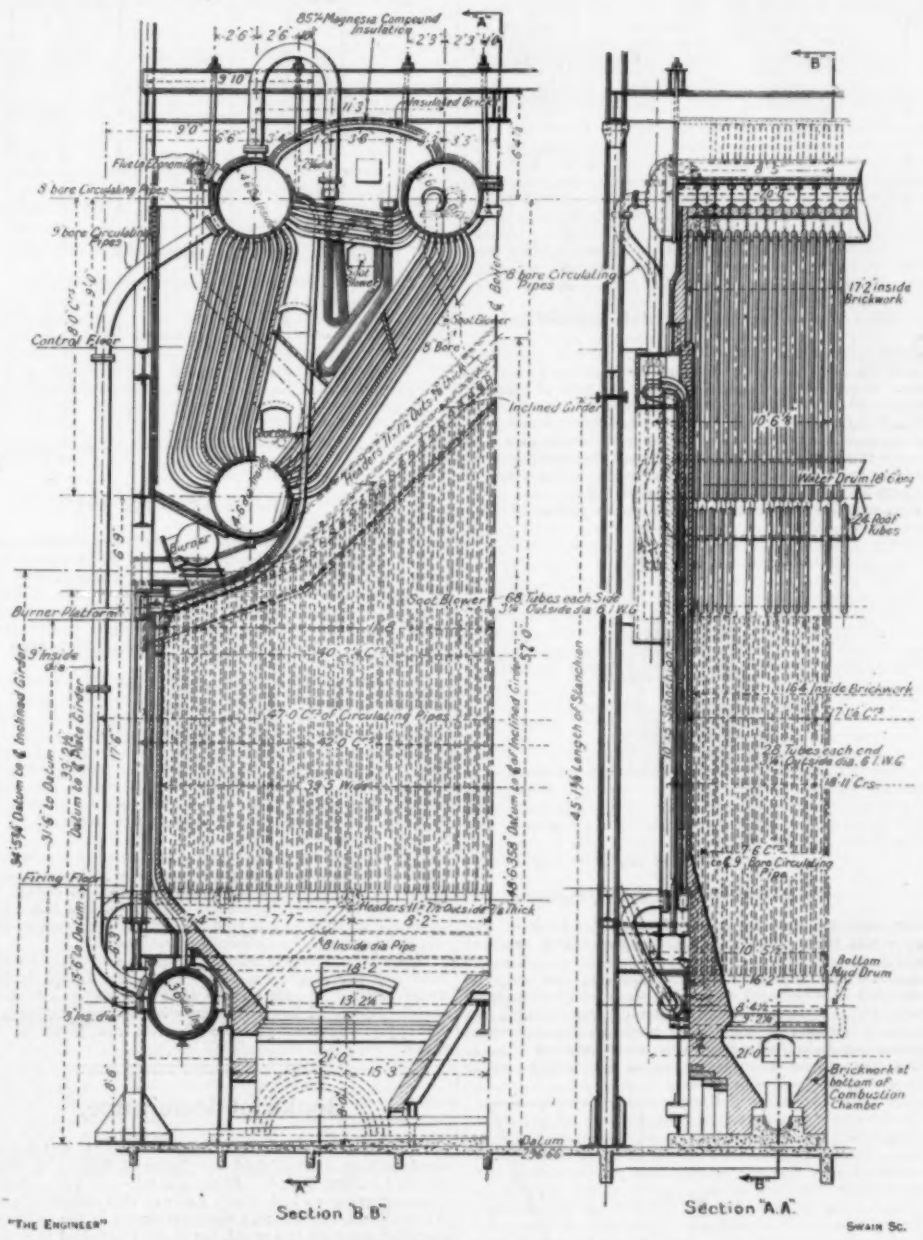


FIG. 3—SECTIONS OF PULVERISED FUEL BOILER FOR BIRMINGHAM

covered by refractory material. Two additional large mud drums fed from the main drums were situated at the bottom of the combustion chamber and supply water to the various water-cooling elements. The approximate dimensions of the boiler and combustion chamber were 40ft. by 20ft. by 60ft. high, and economisers and grit catchers were superimposed.

It was unfortunate that the coal strike had prevented these boilers from being run as yet and also that more information about the radiation boiler was not available. It would seem from consideration of design that the latter would be more suited to conditions where the load factor and volatiles in the coal were high, while the Birmingham boilers should show good results at all loads and with the very poor quality coal that will be used there.

THE Solway Viaduct, which links England and Scotland, running from Bowness on the Cumberland side to Annan on the Dumfriesshire side, is now in such a highly dangerous condition that the authorities are forbidding its use even by pedestrians. The viaduct passes above the sands of the Solway Firth, and swift tides ebb and flow beneath it. Its closure will mean a detour of 20 miles in order to pass from the one shore to the other.

A New Rectifier.

IN a paper appearing in the March issue of the *Journal* of the American Institute of Electrical Engineers Messrs. L. O. Grondahl and P. H. Geiger describe a new electronic rectifier. In the course of an investigation on copper oxide formed on a piece of copper it was observed that the resistance of the combination was less when current flowed from the oxide to the

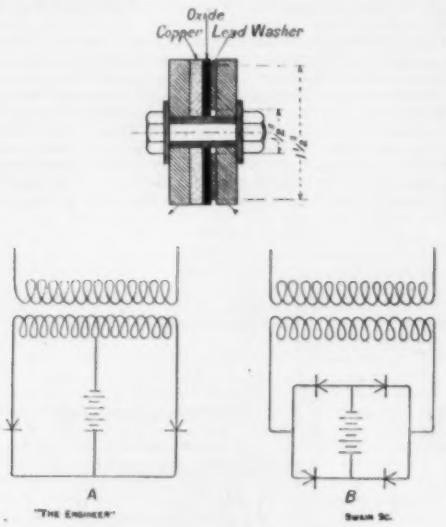


FIG. 1—RECTIFIER ELEMENT AND CONNECTIONS

copper than when it flowed in the reverse direction, and this led the authors to design rectifier units on these lines. A rectifier element—see the upper part of Fig. 1—consists of a disc of copper with a layer of copper oxide formed upon it, good electrical contact being made with the exposed surface of the oxide layer by means of a lead or metal foil washer. Both the copper disc and terminal member are, in fact, conveniently made in the form of washers and assembled on an insulated bolt.

The rectification action appears to be restricted to a

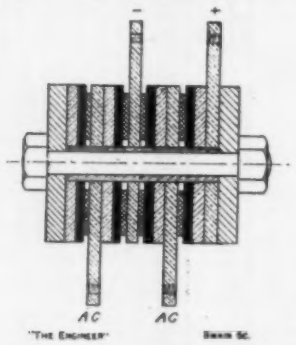


FIG. 2—FULL-WAVE RECTIFIER

microscopically thin layer at the junction between the copper and the oxide, and it takes place entirely without electrolytic or other observable physical or chemical changes. Any number of individual elements may be assembled in series and in parallel so as to form rectifier groups for any desired value of current and voltage, two standard methods of connecting rectifiers for full wave rectification being shown in the lower part of Fig. 1, whilst Fig. 2 shows an assembly of four copper oxide

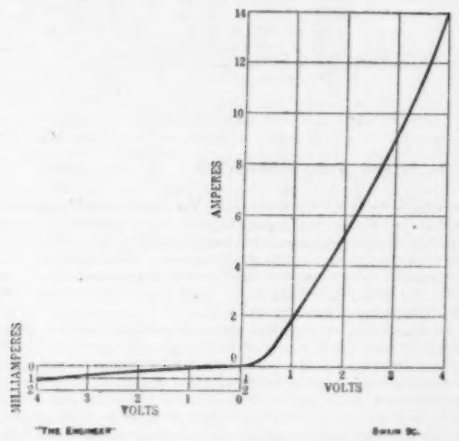


FIG. 3—VOLTAGE AND CURRENT CURVE

rectifier elements into a group for full-wave rectification, the connections being the same as that indicated at B in Fig. 1, where no central tapping on the transformer is required. With good ventilation such a unit will supply an unidirectional E.M.F. of 6 volts and a current depending on the area of the elements.

In order to dispose of the lost power in the rectifier, ventilating fins may be provided, but with current densities greater than 2 ampères per square inch a forced air draught or immersion in oil is necessary. A rectifier provided with ventilating fins and immersed in oil has been operating continuously at 3·5 ampères per square inch. The necessity of making special provision for dissipating the heat arises from the fact that for a given capacity the volume and therefore the radiating surface of the rectifier itself are comparatively small.

The behaviour of the rectifier is said to be constant and does not depend on a point contact, as in the case of a crystal rectifier, its resistance being so low that large currents can be dealt with. The whole area at the junction between the copper and the oxide participates in the rectification, and there is nothing that would suggest the idea of a sensitive spot. The curve—Fig. 3—shows the relation between current and electromotive force in the two directions, through the copper oxide, the part of the curve that represents the current in the high resistance direction having been drawn to a scale 1000 times as great as that of the remainder of the curve, and the scale for currents above the horizontal axis is in ampères, whilst that below the horizontal axis is in milliampères.

The efficiency of a full-wave rectifier composed of four washers is shown in Fig. 4, the efficiency shown being the

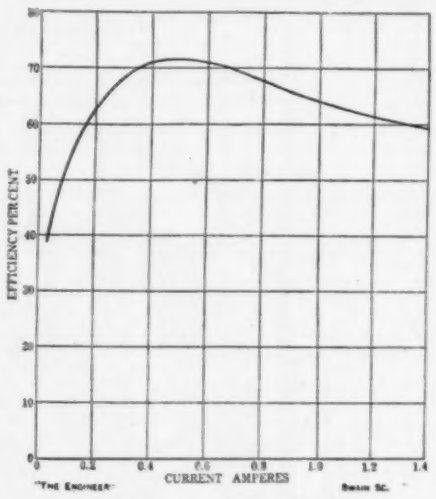


FIG. 4—RECTIFIER EFFICIENCY CURVE

ratio of direct-current watts to alternating current input watts. True power efficiencies of over 80 per cent. have been observed. Since the rectification ratio at very low voltages approaches unity, it follows that the efficiency of the unit as a rectifier at very low voltages approaches zero, but at the voltages that are common in the usual applications of a rectifier, the ratio is so high that the variations are not often important.

If a rectifier of this type is used to supply a practically constant output as is required for battery-charging, the losses in the high-resistance direction remain nearly constant, while the losses in the low-resistance direction decrease with a decrease in the charging rate. For this reason it is sometimes advisable to use a larger number of elements for a rectifier with a small output than is required for one with a larger output. The number of elements required for a given power output also depends on the method of cooling.

For applications requiring a current of a few tenths of an ampère or less, such as supplying the plate current of valves, it is sometimes necessary in order to obtain the maximum efficiency to use an element of less than 1¼in. diameter or to adopt a smaller output per washer than would be employed in other applications.

While investigations relating to the theory of the rectifier have not yet reached a point where the action is fully understood, it is safe to say that the theories that are usually advanced in connection with contact rectifiers do not apply. Several possible theories are given in the paper.

Books of Reference.

"CHEMICAL Engineering and Chemical Catalogue," third edition. Published by Leonard Hill, 173, Fleet-street, London, E.C. 4. Price 10s. 6d.—As we explained when referring to last year's issue of this excellent work, it is really far more than a mere catalogue in the ordinarily accepted sense of the word, for it does not deal only with the products of one firm. What it does do, and it does it exceedingly well, is to tell the reader where every chemical—or, at any rate, a vast list of them—can be obtained, and where, also, a varied selection of chemical plant, of raw materials, and of machinery used in the laboratory or in the chemical manufactory are procurable. Then, too, there are a list of trade marks and trade names, and an index of "industrial applications," which recommends possible directions in which various commodities, articles or processes may be needed, and occupations or trades in which various chemicals, &c., may be employed. This section, if useful in no other direction—and, as a fact, it will probably be found useful in many ways—should prove valuable to those seeking for further outlets for their products, as an indication of the possibilities of further application of chemicals and plant to different trades. Following it is a general reference section, which contains, among a host of other things, a long series of tables, giving data of most diverse nature, the like of which it would certainly be hard to find in any other single volume. Finally, there is a section devoted to technical and scientific books. Altogether it forms a really first-class book of reference.

ALL the locomotive, carriage and wagon works of the London and North-Eastern Railway went on full time last Monday.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Immovable Market.

THE iron and steel industry of the Midlands and Staffordshire maintain a regular though restricted output. Business on 'Change in Birmingham to-day—Thursday—was lifeless. The market, for the time being, seems immovable. The persistent abstention from buying causes deep misgiving in iron and steel-producing circles, especially where orders accumulated during the strike are coming to an end. There are, of course, big industrialists and groups of industrialists whose commitments leave very little unemployment capacity, but employment is becoming less regular in other quarters. Re-rollers in particular are badly off for work. The whole situation turns on the coke question and relief in that direction would make an appreciable difference to material prices, strengthening buyers' hands and easing producers' costs. Merchants are hopeful that the position as regards prices will become easier during the next few weeks, and better business is looked for after the Easter holiday. Iron and steelmasters, however, I regret to state, do not generally support this view.

Pig Iron.

Whatever might be the case in other markets, nothing has occurred to relieve the critical position of Midland blast-furnaces. Production costs threaten to advance further in the second quarter, 2s. a ton more being demanded by ovens for blast-furnace coke. Ovenmen are firm in their demands, and consequently furnacemen limit their commitments as far as they can safely do so, taking some risk of having to pay special prices for emergency lots, as they have done during the past three months. The blast-furnaces are in the grip of coke suppliers. Those furnaces which stand on an independent footing, as many in the Midlands do, are having a desperate struggle to make ends meet. Pig iron buying is almost at a standstill. Prices are upheld by the cost of production. Many smelters slightly reduced prices recently to meet the insistent demands of consumers, but concessions have not gone far enough to induce merchants and foundrymen to come on the market again, except for small tonnages, to carry them on till they can buy on more favourable terms. Quotations are unchanged, Derbyshire foundry being £4 2s. 6d.; forge, £3 17s. 6d.; Northamptonshire foundry, £4; forge, £3 12s. 6d.

Blast-furnace Relighted.

Despite the difficulties which beset the raw iron industry at the moment, additional plant is being brought into operation in the Black Country. Operations have been resumed at one of the smaller blast-furnaces at the Earl of Dudley's New Level Works, Brierley Hill. This furnace has been standing idle for several years, and its re-entry into the list of productive establishments gives considerable satisfaction, and shows that optimism, as to the future of the iron trade in this district, is still prevalent.

Finished Iron.

In the wrought iron department activity relates chiefly to marked bars, which are in steady demand for use in connection with the building of rolling stock and other best engineering work. The price remains firm at £14 10s. The trade in Crown bars, which continue to be quoted £11 10s., is extremely quiet, while hardly any buying of common bars even at £10 10s. is taking place. The British material is out of the running, with Belgian No. 3 iron now procurable at about £6 delivered in the district. Ironmasters do not speak hopefully of the second quarter's prospects, inquiries up to now having been far from numerous.

Steel.

The position in the steel department shows no change on the week. Values rule high and business is small and cautiously placed. Many of the mills have heavy order books in particular descriptions of steel, chiefly those which enter into constructional and marine engineering. But there are unmistakable signs that the arrears are being worked off very rapidly. The amount of business coming in to replace the old is only small. The improvement in supplies is maintained, and it is this week reported that most plate mills are able to promise delivery within two or three weeks. Plates are officially quoted at £9, but 5s. less than that would be accepted. Steel sections are offered at £7 17s. 6d. to consumers who are prepared to enter into contracts. For prompt supplies from 5s. to 7s. 6d. more is required, pressure for delivery continuing. There is very little business being done in billets, either home or foreign, and recent values rule.

Sheet Values.

As a result of the improvement in demand for galvanised sheets prices have firmed up somewhat, district mills having increased their quotation 5s. per ton. They now generally quote £15 5s. f.o.b. for 14-gauge galvanised corrugated sheets. It is reported that a few mills are asking £15 7s. 6d., but this is unconfirmed. Business is reported to be slightly better alike in home and export markets.

Birmingham Sewerage Scheme.

A Birmingham sewerage scheme will form the subject of an inquiry by Mr. H. R. Hooper, Inspector of the Ministry of Health, in Birmingham, on April 5th. The City Council has made an application for sanction to borrow sums aggregating £313,000 for sewerage purposes. The detailed works and the sums it is sought to borrow are as follows:—Reconstruction of Section 3 of the Cole Valley eastern outfall sewer, £82,000; construction of a new outfall sewer at Spring-lane, Erdington, £30,300; provision of main sewer in connection with the development of the

Fox Hollies Housing Estate, and the provision of a sewer in Gospel-lane, £47,200; construction of sewers at Hay Green-lane, Bournville, £13,100; construction of Section 5 of the Rea Valley main sewer, £140,500.

Pits in Peril of Flooding.

A grave situation threatening the flooding of the mines has again developed in the South Staffordshire coalfield as the result of the official announcement, on Saturday last, that the Buffery Colliery Company, Dudley, which employs 200 miners, has gone into voluntary liquidation. This company guaranteed the continuance of the three pumping engines without the aid of which mines in the district would soon be filled with water. Other colliery owners in the area, a fortnight ago, voluntarily consented to increased payments under the tonnage rate to enable the pumps to continue. This week at a private meeting it was decided to maintain the working of the Windmill End and Buffery pumps until midnight on Monday next, pending a meeting of the colliery proprietors on Friday, when possibly some scheme which will obviate the necessity of stopping the engines permanently will be devised. The situation is one of considerable gravity, for in the event of failure to arrive at a financial settlement, a number of collieries in the northern portion of the district will inevitably be flooded and there will be a grave possibility of a far larger area being affected in the near future. A few years ago the adjoining district of Tipton had to be abandoned following the submerging of the coal seams, owing to a sudden failure of one of the pumping engines. The recent termination of the agreement under which the Buffery Colliery Company had been contributing £100 a week towards the cost of working the engines, in addition to supplying gratis all the fuel required for the purpose, has necessarily thrown a serious financial responsibility upon the Old Hill Committee; and apparently the only way it can be removed is by a substantial increase in the revenue from the colliery proprietors in the northern portion of the area. At present the tonnage rate is 9d., and the possibility of continuing the working of the engines will, in all probability, depend upon the willingness of colliery proprietors to pay such increased levy as will cover the cost involved. The feeling is that owners will agree to some such scheme for their own protection.

Cannock Coal Slump.

So pronounced has the slump in the Cannock Chase coal trade become that over 2000 miners have signed on the unemployment register at Cannock Exchange. Collieries in this district have not been fully working for the last month, but during the past week the demand for coal has further decreased, with the result stated. So serious has the position become that it has been found necessary to open a temporary branch exchange at Hednesford. Apparently the slump is affecting only a few collieries, but they are affected to a marked degree, the West Cannock and Rugeley pits especially. High prices and the slow call for household coal are said to be the main cause of the dearth of orders, though industrial grades are selling none too readily. It is remarkable that whereas two months ago there was on view at the local exchange a notice asking for 400 men at once, there should now be such a large number unemployed.

South Staffordshire and East Worcestershire Miners.

At the first meeting of the Joint District Board for the Mining Industry of South Staffordshire and East Worcestershire, following the completion of the new agreement, Mr. H. W. Hughes was appointed chairman, Mr. Samuel Edwards vice-chairman, and Messrs. T. Clare and H. Whitehouse joint secretaries. It was decided that the wages for April should continue at 57 per cent. basic rates.

Obituary.

I regret to have to record the death on Monday of Mr. Joseph Frederic Pearson, a well-known Midland iron manufacturer, of The Birches, West Hagley. He had been in failing health for some months, and was in his seventy-first year. Educated at Brewood, he afterwards went into his father's business at Netherton Furnaces, near Dudley, and in the course of a long business career, had had interests in many concerns in the iron and steel trades in North and South Staffordshire and in Northamptonshire. He was President of the Birmingham Exchange from 1910 to 1916. He retired from business some seven or eight years ago.

Extensions to Stourbridge Gasworks.

Stourbridge Town Council on Monday decided to spend £15,000 on an extension to the vertical retort plant at the gasworks. The Gas Engineer stated that during the past seven years the production had risen from 312,000,000 cubic feet of gas to the present production of 370,000,000.

Unemployment.

An improvement all round is recorded in the Ministry of Labour's return showing the number unemployed in the Midlands. The current total is less by 2240 than that given last week, though on that occasion there was an increase of 2844 on the previous total. Of the whole 101,070 are men, 2331 boys, 27,501 women, and 3138 girls.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Boiler Design.

PROBLEMS of boiler design were discussed by Mr. Harold Lee, the President of the Manchester Steam Users' Association, at the annual meeting of that body. Although in the last fifty years great strides had been made in the science of engineering as applied to boiler construction, Mr. Lee urged that there was still much need for such services as the Steam Users' Association offered. At the present time, he said, a great deal of activity was being shown in boiler design, owing, in part, to the invention of the turbine. Mild steel, which in the past had proved an exceedingly reliable material for use in the construction of boilers, was behaving admirably under the new conditions, and he saw no immediate likelihood of its having to be superseded by costly alloys. Moving the adoption of the annual report, reference to which was made in THE ENGINEER a fortnight ago, Mr. Lee said that not since it was established had there occurred a preventable explosion of any boiler that carried the Association's guarantee. Its activities had not been confined to the official sanctioning of safe working pressures, but careful note had also been taken of failures, and the knowledge that had been acquired as a result had proved extremely valuable in forming an estimate of the probable behaviour of new forms of construction.

Proposed New Bridges.

The movement to secure additional traffic facilities over the Manchester Ship Canal has been carried a stage further by the Eccles Trades and Labour Council, which, in a statement addressed to the Minister of Labour, urges the need for the construction of a new high-level bridge in the Weaste district, the widening of Barton Bridge, the construction of a new high-level bridge or a tunnel in proximity to Barton Bridge, and the provision of increased transport facilities through Trafford Park and wider roads. A conference is suggested by the Council between the Ministries of Health, Transport and Labour, the local authorities concerned, and the Manchester Ship Canal Company and the Trafford Park Estates, Ltd., for the purpose of discussing and deciding the method of meeting the situation.

The Six-wheeled Motor Omnibus.

Salford City Tramways Committee is apparently satisfied with the behaviour of the six-wheeled motor omnibuses which have been running on the city traffic routes during the past two months. During that period four vehicles—two thirty-two-seaters and two twenty-four-seaters—have been in use, the former running to the busy Manchester boundary of the city and the smaller omnibuses operating a cross-country service from Swinton to Whitefield. All four are of the single-decker type, and the proposal of the Committee is to purchase twelve more of similar design, but of thirty-two-seater capacity.

Back to Full Time.

In this area the Gorton and Dukinfield railway engineering shops were affected by the decision of the London and North-Eastern Railway Company to resume full-time work at the beginning of the present week. At these two works about 1500 men resumed normal operations.

A Subsidiary Power Company.

The development of the Mersey Power Company, a subsidiary undertaking of the Salt Union, Ltd., was dealt with by Mr. G. H. Cox in his presidential address at the annual meeting of the Salt Union at Liverpool. With additions that have only recently been completed, the power company's plant, which includes three turbo-alternators and seven boilers, has a continuous load capacity of 24,000 kilowatts. With this plant it can produce up to 126,000,000 units a year, or more than double its total sales in 1926. Altogether, the distribution system has necessitated the provision of 161 miles of cables and forty-seven sub-stations. Last year the company's sales of current were 50,760,000 units, compared with 45,725,000 units in 1925, whilst the sales during the first month of this year were equivalent to 62,500,000 units a year. Mr. Cox claimed that the company is now in the front rank of modern power stations, both as regards cheapness of production and the sale of current at low prices.

Personal.

On his acceptance of the position of chief engineer to the London and Home Counties Joint Electricity Authority, Mr. S. J. Watson, chief engineer and manager of the Salford Corporation Electricity Department, has tendered his resignation of the latter post. Before accepting the appointment at Salford four years ago, Mr. Watson was electrical engineer at Bury, a position which he had held for over twenty-five years. He was partly responsible for the drafting of the South-East Lancashire electricity scheme. Early in 1923, when he left Bury for Salford, a beginning was made with the erection of the important new generating station of the Salford Corporation at Agecroft.

Non-ferrous Metals.

The experience of the non-ferrous metals markets since I wrote last, and more particularly during the opening days of the present week, has not been a happy one. All sections have suffered a relapse, which, as is usually the case, has been the most spectacular in respect of tin. Buying of this metal, both on continental account and in America, has only been moderate, and with a fairly substantial increase in the total stocks in this country some reaction from the recent firmness was to be expected. Up to the close of last week this had been by no means serious. Early this week, however, the fall was accelerated, and at the time of writing cash metal at £307 has lost over £8 compared with a week ago. In the case of forward positions the drop has been much less pronounced, with the result that the difference between cash and three months has narrowed from about £15 to £10. Incidentally, current values are now back to where they were at the middle of last month. A similar setback has occurred in the case of copper. Buying in this section of the market from all sources has been on rather quiet lines, and values have pretty well lost all the ground gained during the past five weeks. Both lead and spelter have been in relatively slow demand, and prices here have shared in the general setback.

Iron.

One of the few notable developments on the pig iron market during the past week has been the somewhat steadier tone which has been in evidence, due, it is believed, to the higher coke prices which blast-furnace owners will have to face at the beginning of April. It is unfortunate that this should have occurred, for it must inevitably have a delaying influence on the price-lowering process for which pig iron users are alleged to be waiting. Makers are certainly less disposed to shade values on the orders for small parcels for early delivery which comprise the bulk of the limited business that is currently passing, although it would probably still be possible in the case of a consumer willing to place a contract for a good quantity to secure a slight concession. For delivery into the Manchester district Derbyshire and Staffordshire irons are offered at about 90s. per ton, Middlesbrough at 92s. 6d., Scottish makes at 104s. to 105s., and West and East Coast hematites at about 97s. The demand for manufactured iron continues on an extremely disappointing scale, and with a view to encouraging buying and so getting the plant at work at something approaching normal capacity, a further reduction of 15s., which brings Crown bars back to their pre-strike level and second quality material to within 5s. of that mark, has been put into operation by the Lancashire Association this week. Crown bars are thus now being offered at £11 per ton and seconds at £10.

Steel.

With the knowledge that Lancashire constructional engineering concerns have good prospects of substantial additions to work in hand, the steel market is expecting an improvement in buying from that direction, although it is not improbable that buying will be deferred until steel values are on a firmer and, at the same time, lower foundation, for construction engineers, on their part, are not unaware that by this time many of the rolling mills are less happily situated from the point of view of work awaiting execution than they were a month or two ago. In the meantime, the demand for steel on this market remains on a limited scale, and no appreciable changes have occurred in quotations. Boiler plates range from £11 7s. 6d. to £11 10s.; ship and tank plates from £8 7s. 6d. to £8 15s.; joists and sections from £7 17s. 6d. to £8; basic steel bars are quoted at about £9; forging blooms at £9 10s.; and ordinary acid wire billets at £11. There is a very slow demand for re-rolled bars, quotations for which have an easy tendency at £8 15s. per ton. Galvanised sheets are nominally steady at £15 5s. per ton f.o.b., for the usual Indian specifications, but the fact of the matter is that buying has been so inactive during the past week that it is not an easy matter to say what actual market values are at the present time. Prices quoted here by continental steel makers have displayed a markedly easier tendency, but they have failed to bring out any additional demand. For delivery to buyers' works in the Lancashire area, for cash against documents, ordinary plates are now quoted at £7 5s. to £7 7s. 6d.; Siemens plates at £7 10s. to £7 12s. 6d.; steel bars at £6 2s. 6d.; joists and sections at £6 2s. 6d. to £6 5s.; sheet bars at £5 12s. 6d. to £5 15s.; and billets at £5 7s. 6d. to £5 10s. per ton.

Scrap.

Whilst there is a certain amount of inquiry in the market for non-ferrous metal scrap, actual buying is comparatively slow. Scrap zinc is quoted at about £25 10s. per ton, lead at £26, clean light copper at £56 10s., best selected gun-metal at £52, brass rod turnings at £39, and heavy yellow brass at £45, for graded qualities and including delivery to users' works.

Manchester Association of Engineers.

The annual meeting of this society was held on Friday, 25th ult., at the Engineers' Club, Manchester, when the seventy-first annual report was presented. It appears there was a drop in the number of members during the year just closed from 769 to 737; but there should be no special cause for alarm on this account, as the condition of the engineering industry in Lancashire during the past year has been the worst within living memory. Although the Association has a rather substantial overdraft at its bankers, it possesses investments to the value of several thousands of pounds in the hands of its trustees, and with careful attention to the reduction of some of the working expenses there is every reason to believe that the society will speedily regain its former financial position. The list of papers read during the last year in both the senior and junior sections shows that the Association is maintaining its position in this respect, and under Sir Benjamin Longbottom's presidency the social activities were outstanding successes. Sir Benjamin was the first President to wear the badge of office, which was presented by several past-Presidents. Mr. S. H. Heywood was elected President of the Association for the ensuing year. Mr. Heywood is well known in the Manchester district, and although he has not hitherto taken a very prominent part in connection with the engineering institutions, it is felt that the office of President is in safe hands. It is a matter for regret that Mr. F. Hazelton, who has acted as secretary for thirty-seven years, has had to tender his resignation from this post, and the Association is showing its recognition of his services in a suitable manner.

The Engineers' Club, Manchester.

The fourteenth annual general meeting of members of the Engineers' Club, Manchester, was held on Tuesday last, when Alderman W. Walker, M.I. Mech. E., M.I.E.E., was elected President for the ensuing year, to succeed Alderman F. J. West, M.I. Mech. E. In the Committee's annual report it is stated that although the receipts during the past year show a slight falling off compared with those of the preceding year, the Committee is of the opinion that that is only a temporary state of affairs caused by the exceptional depression in the engineering industry. Resignations and deaths were more numerous. On the other hand, the report goes on to say, there was a greatly increased appreciation of the Club amenities on the part of the various engineering institutions. The

Institutions of Mechanical and Electrical Engineers, the Manchester Association of Engineers, the Institution of Automobile Engineers, and the Manchester Metallurgical Society all hold their meetings at the Club. The Students' Trust Fund, founded by the late Mr. George Thomas, J.P., and other members of the Club, continues to increase, but so far no calls have been made on the Fund. The Committee is anxious to remove the impression which prevails outside the Club that there is always a waiting list for membership. When the Club premises were enlarged, the waiting list was absorbed, and there is now room for further members, while sons of members are admitted, provided they have the necessary qualifications, at the age of twenty-two. The balance sheet and profit and loss account show a very satisfactory state of affairs, upon which the Committee is to be complimented. Mr. J. Owden O'Brien, M.I. Mech. E., was re-elected hon. treasurer, and Mr. H. Richardson, M.I. Mech. E., hon. secretary.

BARROW-IN-FURNESS.

Hematite.

There is no alteration in the tone of the hematite pig iron market, nor is there likely to be to any extent until there is a reduction in the price of coke. There is not the slightest doubt that the cost of that important factor is helping to keep up the price of pig iron, and that, in its turn, is keeping customers from buying, since they hope that a reduction will be made by the East Coast coke producers. There is business to come, but consumers are wary and are not prepared to place orders for forward delivery, being content to order only for immediate requirements. This state of things is causing some worry locally, but nothing can be done to remedy the condition here. It rests with the coke producers, who, in time, will probably meet the iron producers after they have recouped themselves from the losses of last year. At present the makers are busy enough, and they are likely to be for some months yet, for big contracts were placed before the smelters got back to work, and it will take some time to get level with the requirements at home and abroad. Iron ore is in steady demand, and there is a certain proportion going out of the district. The latter trade may develop further. The steel trade is not very bright, although all the mills are engaged. The trouble is that orders are not coming in fast enough.

Electricity.

Barrow is still trying to obtain powers from the Electricity Commissioners to spend about £60,000 on extensions, and at the moment conferences are taking place. It is not generally known, and certainly not in Barrow, that, contrary to the original conception that Barrow was too isolated to be connected up to the regional power stations under the new scheme, the network is coming eventually to Barrow, and will connect up to Carlisle. This may account for the Commissioners' attitude.

SHEFFIELD.

(From our own Correspondent.)

Condition of the Steel Trade.

"BRITISH steel works," said Mr. W. L. Hichens last week at the annual meeting of Cammell Laird and Co., Ltd., at Sheffield, "are all busy for the time being, but they are occupied largely with the arrears which accumulated during the coal dispute. Whether fresh orders will suffice to maintain the present scale of production is doubtful." These two sentences sum up what I have been reporting for several weeks with regard to the condition of the local heavy steel trade, and the state of things which they indicate still continues. The open-hearth furnaces of the district are maintaining an output which is not far short of the maximum, but new business is scarce. In various parts of the country steel users have on hand good quantities of foreign material which was contracted for during the strike. That is one reason for the paucity of new orders. Another is that consumers are waiting for a fall in prices.

Cheaper Steel Wanted.

Everybody seems to be waiting for cheaper pig iron, which would enable steel to be produced at lower rates. There is no sign yet of this cheaper raw material, however. Rather does the prospect of it seem to be more remote, as there has been an official advance of 2s. per ton in the price of blast-furnace coke. The menace of continental competition is growing. Iron and steel in a crude form, from more than one European country, is being offered here at prices which are distinctly favourable to the re-rollers. Mr. Hichens referred to this point. "It is of primary importance," he said, "that a concerted effort should be made to reduce costs all round, for our trade will infallibly slip away from us unless we are able to manufacture as cheaply as our foreign rivals. For my own part, I am convinced that it can be done without lowering the standard of living in this country. But it involves a far closer co-operation between all sections of the community than exists to-day."

Tool Trade Improving.

An improvement has been noticed during the last week or two in the demand for certain classes of tools, and this has now shown further slight development. Owing to the considerable orders for new tonnage that have been placed recently, the requirements of the shipyards show an increasing tendency, and there is a better call for engineers' small tools, particularly high-speed cutters. Makers of colliery equipment and tools are enjoying much more activity than they did during the dispute, but they are not yet fully employed, as many of the collieries are doing badly, and are severely restricting their expenditure on plant. A little improvement is reported in the trade for building tools. The absence of Russian business is disappointing. In 1925 that country was Sheffield's biggest customer for files and saws, taking quantities valued at £104,142 and £139,981 respectively. In 1926 the figures fell off seriously, being only £55,442 and £28,318 respectively. Business has been practically at a standstill for a considerable time. During the present year no orders of any consequence have been received for these tools, and there are no inquiries which suggest the placing of early contracts. Trade with China in the same commodities, which is normally of a limited but useful amount, has fallen off very considerably during the last six months.

A Couple of Orders.

Metropolitan-Vickers, Ltd.—who have again been able to declare a dividend of 8 per cent. on the ordinary shares—have secured an important order for the supply of electric motors in connection with the electrification of a portion of the Spanish railways. The work will be carried out at the company's Sheffield establishment. It is understood that the contract refers to the scheme in the Barcelona area. Each motor coach will be fitted with four 250 H.P. motors, but for longer distances special coaches will be utilised, which will have six motors. At present Spain has 24 miles of electrified track, but it is estimated that by the spring of 1929 this distance will be increased to 300 miles. Another order reported during the week is one secured by Brown Bayleys' Steel Works, Ltd. It is for stainless steel for a chemical works plant, and is on a fairly large scale. While dealing with individual firms, mention may be made of the fact that the pipe foundries of the Staveley Coal and Iron Company are at present working at full capacity. The important contract received during the coal dispute for many miles of pipe line for Cairo is being fulfilled, and there are also on the books a large number of orders for cast iron pipes required in this country.

Cutlery and Plate.

There is no improvement to report in the state of the cutlery and plate trades. The briskness in buying which is generally expected at this time of the year has not yet developed, and the general trade, done through shopkeepers, is on only a moderate scale. There are still a number of valuable contracts on hand for hotels and restaurants, and fair quantities are being sent to various parts of the Empire. The well-known firm of Mappin and Webb, Ltd., had a much improved experience in 1926, and was able to resume the payment of ordinary dividends. At the annual meeting the chairman reported that during the year they secured contracts for supplies to some of the new London hotels, and also to railway and steamship companies, including seven new passenger liners. With regard to the present year, however, he announced that things had opened badly. There was no doubt, he said, that the full effect of last year's happenings was now being felt everywhere, and that the spending capacity of the public had been reduced. Details are now available of the proposed new French Customs tariff on cutlery and tools. The classification has been extended and varied, so that comparison with the old tariff is difficult, but increases seem to be the general rule, and in some instances the new rate is three times as high as the old.

Progress of New Colliery.

The sinking of a colliery at New Upton, 10 miles north-west of Doncaster, which has been in progress for the past three years, has reached a very advanced stage, and it is expected that the Barnsley seam will be reached next June. The interests in the company are shared by the Cortonwood Collieries, Ltd., Wombwell, and Bolckow, Vaughan and Co., of Middlesbrough, and the royalties extend to about 8000 acres. The downcast shaft has now reached a depth of 558 yards, and it is expected that the Barnsley bed will be struck at about 700 yards. The upcast shaft is at present 475 yards deep. In this case a good deal of hindrance has been caused by water difficulties, which have been overcome by pumping. The colliery has rich potentialities, as it possesses several other valuable seams in addition to the Barnsley. The sinkers in the downcast shaft have just struck the Melton Field seam, which is good coal, 4ft. thick, and there are also the Haigh Moor, Parkgate and Shafton seams. It is hoped that the colliery will develop into one of the largest in South Yorkshire. An output of 2000 tons a day is looked for in twelve or eighteen months from now, while the eventual aim is 30,000 tons per week, and employment for 4000 men. The pit will derive electric current from Carlton Main, which is in the circle linking Frickley, Grimethorpe and Brierley collieries. The shafts are being lined with concrete blocks, made by the colliery company, and backed by a layer of rubble. Throughout the sinking, permanent steel headgear has been used. The engine-house is equipped with one of Markham's giant engines, of something like 2000 horse-power. The company owns between 500 and 600 acres of land, part of which will be used as a site for the colliery village. For housing purposes, a large brick kiln, erected by the company close to the pit, produces several million bricks per annum. Up to date, eighty houses are built and occupied in the old Upton village, while in the new village 100 are ready for occupation, with the exception that the water and sewage schemes have to be carried out. Another batch of 262 houses is being built on the new village site. After June, when the company should be in a position to take on more men, there will be even more activity on the housing sites. Good progress has been made with the erection of the surface plant.

New Mining Institute.

The West Riding County Council has started building operations at the new South Yorkshire Mining and Technical Institute at Dinnington. The total cost of the scheme will be about £23,000, towards which a grant of £17,000 has been made by the Miners' Welfare Committee. The institution is to be an important and well-equipped one, and will provide excellent facilities for technical and general adult education for the mining communities in South-East Yorkshire. The laboratories will include separate provision for mining technology, electrical engineering, mechanical engineering, and mine surveying, with drawing-office, science laboratory, dark room with photometric bench and gas cap demonstration apparatus, and a smaller room for analysis of gases, mine air and fuels. The women's side will contain a domestic science laboratory, and there will also be a commercial department.

NORTH OF ENGLAND.

(From our own Correspondent.)

Ironworks Restart.

THE Jarrow ironworks of Messrs. Palmers' were restarted this week for the manufacture of hematite and Cleveland pig iron. The whole of the plant has been idle since the miners' dispute of 1921, with the exception of a brief period of four months in 1923, when two furnaces were put into blast. With the restarting of the works employment has been found for about 600 men. When the steel works and rolling mills are in full operation about 2500 men are employed, but at present only two blast-furnaces have been put into operation. The output of the two furnaces will reach 2000 tons of pig iron per week. Some of it will be used by the Palmer Company in its own foundry, but the bulk will be for sale for use in iron and steel foundries and for export. The blast-furnaces now blowing on the North-East Coast total 48.

Cleveland Iron Trade.

Pig iron consumers are still pursuing a cautious policy, and are confidently anticipating price concessions. The result is that transactions are almost entirely confined to small parcels to cover urgent needs. Most of the Cleveland firms have good order books, but output capacity is enormous, and unless a flow of trade is experienced in the second quarter of the year, makers will be unable to keep works fully occupied over the autumn and winter months. Ironmasters would be glad to see prices on a lower level, which would permit of an expansion in the volume of business at home and abroad, but they point out that cost of production leaves very little margin of profit, and in a few cases involves actual loss, so that it would appear that working expenses will have to be lowered before a material fall in current market rates can be looked for. The quantities of pig iron available are very limited, but are ample for current requirements, and the re-kindling of the two blast-furnaces at the Jarrow Ironworks promises to increase the supply for the open market. Prices are unchanged, No. 1 foundry being 82s. 6d.; No. 3 G.M.B., 80s.; No. 4 foundry, 79s.; and No. 4 forge, 78s. 6d.

Hematite Pig Iron.

Quietness continues to characterise the East Coast hematite pig iron trade. Mixed numbers are quoted at 85s. per ton, and doubtlessly that figure could be shaded for a substantial order. Makers have to contend with the keen competition of West Coast producers for the home trade and with the continental manufacturers in markets abroad.

Ironmaking Materials.

Imports of foreign ore into the river Tees during March have been very heavy—the heaviest, in fact, for over twelve months past. New business, however, is slow, consumers having considerable stocks, but quotations are upheld. Best Rubio ore remains nominally at 22s. per ton c.i.f. Tees. There is an easier tendency in the coke market following upon the purchase by ironmasters of German fuel. Durham good blast-furnace qualities are now obtainable at 24s. delivered at the works, but users declare that the price is too high.

Manufactured Iron and Steel.

Little change is reported in the manufactured iron and steel trade. Although the first rush for deliveries is over there is still an active demand for shipbuilding material, and, on the whole, the steel mills are busily employed. But new orders are only coming to hand slowly in spite of the fact that any extra rail charges are being borne by the steel makers. Prices are not quotably altered, but unless demand expands shortly, difficulty in maintaining market rates may be experienced.

The Coal Trade.

The position in the Northern coal trade is anything but encouraging. Business is very slow in coming forward, and the requisite volume is wanting to keep the pits fully employed. In the allotment of the Swedish State Railways' order this district has not been very successful, as only about 54,000 tons have come to Northumberland and Durham. Scotland received orders for 15,000 tons. Of the balance, 75,000 tons went to Westphalia and 11,000 tons to Silesia. The c.i.f. prices all round are low. Northumberland seconds are apparently on the basis of 14s. 6d. to 15s. f.o.b., and Durham bunkers about 16s. These are certainly anxious times for colliery fitters, who are faced with relatively high working costs and a small demand in most instances. Merchants, on the other hand, say that not only are inquiries meagre, but that prices are still too high to attract large custom from abroad. The current position is therefore full of perplexities. Northumberland steam coal values do not show any alteration on the week. Prompt loadings are needed to keep the pits going, and 16s. 6d. is an outside price for best qualities. Steam smalls are fairly steady, as large coal is in decreased production. All second-class steams meet with moderate inquiry, and there are ample supplies at about 15s. 3d. Durham large steams continue to be held at 19s. 6d. to 20s. In the best gas coal section late prices are asked, and seconds, though nominally unchanged, have a weak appearance. Coking coals are plentiful, as also are bunkers, and no firmness in these fuels is apparent. There is a good demand for all classes of coke, and although production is large and increasing, prices are steadily maintained. Gas coke is at 22s. 6d. to 23s.; patent foundry cokes, 25s. to 28s.; and beehive and special classes, 30s. to 32s. 6d.

Big Order for Iron Pipes.

Official intimation was received this week by Cochrane and Co., Ltd., of the Ormesby Ironworks, Middlesbrough, that one of the tenders which they submitted for the supply of 7000 tons of cast iron pipes to the Municipal Council of Port Elizabeth, Natal, has been accepted. This order has been on the market for some considerable time, and has only been secured by the Tees-side firm in face of very keen competition from French and German makers. Needless to say, the price has been "cut to the bone" to beat the foreign producers, but Messrs. Cochrane were determined, if possible, to secure the contract in order to assure continuity of work at their establishment.

Coal Miners' Wages.

The state of the coal trade is reflected in the report of the accountants on the proceeds and costs in the county of Durham for the month of February, issued on Wednesday. This shows that the rate of wages, but for the operation of the minimum wage clause in the county agreement, would have been 65·46 per cent. on the basis rate. The minimum percentage in the agreement is 89, and therefore that rate of wage will be paid in April. If wages were regulated entirely upon proceeds and costs they would be 23·54 per cent. lower than the rate that will be actually paid.

Cleveland Miners and Wages.

With a view to raising the general standard of piece workers' wages, the Council of the Cleveland Ironstone Miners' Association has decided to approach the mineowners for a revision of piece rates. A request is also to be made for extra pay for men, who, after working five long days, were not required to work on Saturdays. It is claimed that under present circumstances the men work two and a-half hours for which they receive no pay. The mineowners will also be asked to grant workers one week's holiday a year with pay.

SCOTLAND.

(From our own Correspondent.)

Continued Depression.

THE past week has wrought no change in the industrial situation generally, and markets as a rule are dull and lifeless. Many large shipbuilding and engineering firms have well-filled order books, but others are feeling acutely the lack of fresh business, and have great difficulty in keeping their plants working at even half capacity.

Steel and Iron.

Most of the steel manufacturers are busy in their plate and section mills, and orders on hand are sufficient to keep works active for some time yet. New business, however, is conspicuous by its absence. The demand for sheets has shrunk somewhat, and the works are not so busy, while prices are just steady. Bar iron makers report that buying continues on a very restricted scale, notwithstanding the reduction in home prices. The export price is similar to the home quotation at £11 5s. per ton, but it is expected that keen competition will lower the price for shipment. Re-rolled steel bars are in a similar position. Home prices are fixed at £8 10s. per ton, but concessions have to be made in shipping contracts.

Wages in Manufactured Iron Trade.

Wages in the manufactured iron trade are unchanged in view of the fact that the average net selling price during January and February has been certified at £11 13s. 1·20d. per ton.

Pig Iron.

In common with others, the pig iron market is dull and featureless. The steady flow of business is restricted, and the present curtailed rate of output is generally adequate to meet all demands. Hematite on occasion has been scarce, but supplies of foundry qualities are always plentiful. Prices are unchanged, but the tendency is downward.

Coal.

There are still no signs of a revival in the Scottish coal trade, either in the home or the export trade. Many collieries in need of business are resorting to price-cutting, but their efforts are meeting with a poor response. The industrial demand is far below expectations, and house coal is falling off. Gas and electricity works are taking smaller deliveries, while railway companies still use considerable quantities of American fuel. The difficulty in securing foreign orders is still most marked. Competition from North of England and continental fuels is severe, and local exporters are securing few contracts. Apart from Lanarkshire splints, round coals are more or less inactive, and washed materials are very little better off, washed singles and pearls being the only sizes to show any improvement. Aggregate shipments amounted to 236,269 tons, against 246,238 tons in the preceding week, and 258,868 tons in the corresponding week of last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Outlook.

ON the whole there has been practically no change in the state of the coal trade during the past week, though the foreign demand appears to be slightly less active and there is a tendency to postpone operations. So far this has not affected the market generally, for the reason that most of the leading collieries have very full order books until after the Easter holidays. Inferior coals and dry qualities are rather an exception to this condition, and, in fact, some of them have very great difficulty to maintain regular working, the result being that they are a weak market. For the superior descriptions, however, buyers find it hard to break the prices quoted by the collieries for any further coals which they have to spare. The inquiry from the private consumers abroad is restricted, though there are others of some importance on the market. One from South American buyers is for 20,000 tons for fairly early delivery, while the Mauritius Government has invited tenders for 25,000 tons of Welsh large steam coals, and the Egyptian State Railways have officially notified the various firms, which are usually interested, that tenders will be opened on May 3rd next at Cairo for 100,000 metric tons of large steam coals for delivery, 10,000 tons in May, 50,000 tons during June, and 40,000 tons during July. In the case of the Belgian State Railways' requirements, it is reported that the bulk of that business has been placed for Belgian and Polish coals at prices 2s. 6d. below the offers received from this country. As regards the position in the American coalfield, very little fresh news has so far come through respecting the threatened stoppage of work in the bituminous section. In any event, it is reported that should the strike take place it will not affect more than 30 to 40 per cent. of the workmen engaged, so that it is scarcely likely that this market will feel much, if any, effect for some time.

Colliery Losses.

The effect of the general stoppage in the coalfield last year upon individual undertakings is now being shown, inasmuch as the annual reports of the various companies for the year ended December last are being issued. The extent to which the various concerns suffered can be gauged by the fact that D. Davis and Sons, Ltd., report a loss of £67,790 13s. 11d.; Welsh Navigation Steam Coal Company, £6146 8s. 11d.; Cardiff Collieries, Ltd., £40,688; Powell Duffryn Steam Coal Company, Ltd., £118,810; and Great Western Colliery Company, £100,137. It will take some little time for the collieries to recover, yet a fairly optimistic view is taken, and provided that settled conditions prevail, and the demand generally improves even to a moderate extent, these deficits can within a reasonable time be removed. It is realised, however, that the prospects of shareholders getting any dividend for a twelve month are somewhat remote, except in the case possibly of just two or three concerns which are in a comparatively favourable position.

Trade of South Wales.

The returns of the Great Western Railway Company show that the total trade at the various docks in this district under its control from January 1st to February 20th amounted to 5,013,288 tons, as against 5,526,651 tons for the same period of last year. Imports came to 870,934 tons, as compared with 786,127 tons, so that on this side there was an improvement, but on the export side the report is not so satisfactory, as these totalled 4,142,354 tons, as against 4,749,524 tons. Coal and coke exports have decreased by over half a million tons.

Steel and Tin-plates.

The tin-plate pool for the stabilisation of prices and the regulation of production came into operation this week, after being in suspense since the national coal dispute. This scheme provides for an allotment of £100 per mill by each maker of tin-plates for the formation of a guarantee fund. In cases in which the periodical ascertainment shows an output above a specified standard, 2s. 6d. per basis box is paid into the pool, and where there is under-production 1s. per basis box is to be paid out to those concerned.

Coal Exports.

The week ended March 25th established a fresh record in the exportation of coals from this district since the resumption of work in the coalfield following upon the national coal stoppage. The total reported was 550,207 tons, as against 544,587 tons for the previous week.

Coal Contract.

A contract for the supply of 30,000 tons of Ynyafais large coal for the Swedish Navy between April and June has been secured by Gueret, Llewellyn and Merrett, Ltd., of Cardiff.

Non-unionism.

All the Blaenavon Company's collieries were idle on Wednesday as the result of the men remaining out on the non-unionist question. A number of the workmen have affiliated with the new Industrial Union, the consequence being that mass meetings have resolved not to return to work until the non-unionists have rejoined the Miners' Federation.

Current Business.

The tone of the steam coal market continues to be very steady in the case of the superior descriptions of coal, as the collieries producing them are pretty fully sold for the next few weeks. The weakness in the market applies to dry coals, and inferior sorts for which the demand is slack. The probability of the market feeling any appreciable effect from any stoppage of a partial character which may take place in the American bituminous coalfield is rather discounted, and, as a matter of fact, more attention is being given to the prospects of a threatened stoppage of work in the coalfields of France where the workmen are reported determined to resist the proposed action of the employers in bringing into operation a reduction of wages as from April 1st. Pitwood continues to be a feature of the market, inasmuch as prices for prompt supplies are firmer than ever, and are round about 42s. 6d. per ton ex ship, as against 37s. 6d. last week.

CATALOGUES.

HADFIELDS, Ltd., East Hecla and Hecla Works, Sheffield.—Leaflet on "Hadura" steel hot shear blades.

GARRARD GEARS, Ltd., 109, Kingsway, W.C. 2.—Brochure giving the full particulars, uses and advantages of "Garrard" gears.

MEPSTEAD AND CO., Stanton Engineering Works, Villiers-road, N.W. 2.—List "A" of the "Mepstead" patent rotary pump.

DEAN, SMITH AND GRACE, Ltd., Keighley.—Booklet giving examples of time-saving on various jobs by the use of up-to-date lathes and methods.

THE PARSONS OIL ENGINE COMPANY, Ltd., Town Quay Works, Southampton.—Publication 82 on 56/70 horse-power eight-cylinder paraffin or petrol plants.

THE SUPERHEATER COMPANY, Ltd., 195, Strand, W.C. 2.—The third edition of the booklet entitled "The Installation, Maintenance and Operation of the M.L.S. Locomotive Superheater."

SMITH AND COVENTRY, Ltd., Gresley Ironworks, Manchester.—Section N of catalogue describing a boring, facing and recessing machine for electric motor frames; and Section P on plano-milling machines.

THE WESTINGHOUSE BRAKE AND SAXBY SIGNAL COMPANY, Ltd., 82, York-road, N. 1.—Reprint from *The Railway Engineer*, entitled "Signalling on the Metropolitan and London and North-Eastern Joint Lines, Harrow–Rickmansworth–Watford."

CONTRACTS.

THE BRITISH THOMSON-HOUSTON COMPANY, Ltd., has been successful in obtaining a contract from the London, Midland and Scottish Railway, for the supply of Mazda lamps during the period ending December 31st, 1927.

INTERNATIONAL COMBUSTION, Ltd., of Africa House, Kingsway, London, W.C. 2, announces that it has been instructed to proceed with a repeat order from the Derby Corporation Electricity Department. The order covers the supply of an additional 80,000 lb. boiler complete with drying equipment, "Lopulco" water-cooled combustion chamber, superheaters, economisers, draught equipment, dust-catching apparatus and stacks.

THE BROWN BOVERI organisation has received an order to supply an additional 6000 K.W. extra high-pressure steam turbine for the Langerbrugge power station of the Centrale Electrique de Flandre. This turbine is to work under the same conditions as those at present in operation. It will receive steam at 285 lb. per square inch pressure from an extra high-pressure turbine working at a pressure of 710 lb. per square inch, and will, itself, deliver steam to three further low-pressure sets.

THE MIRRLESS WATSON COMPANY, Ltd., Glasgow, has received an order for pumping machinery from the Indian State Railways for the Kalyan Electric Power Station. The contract includes three 27in. and two 18in. vertical-spindle type motor-driven centrifugal pumps, for supplying the condensing water required for the generating units, and, in addition, nine pumps of smaller size for general service purposes. The order also includes a water screening plant of the Bracket type, 42in. circulating mains and all pipe work from the screens to the condenser and back to the river.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

FERODO, Ltd., asks us to announce that it is opening premises at 39, Charles-street, Cardiff.

THE EMPSON ELECTRICAL ENGINEERING COMPANY, Ltd., asks us to announce that its registered offices have been transferred from 47, Victoria-street, to 27, Chancery-lane, W.C. 2. New telephone, Holborn, 2344.

MR. A. W. EMPSON, who gave up the management of Empson Centrifugals, Ltd., in June last, asks us to announce that he has now resigned his directorship. His address is 46, Christchurch-avenue, N.W. 6. Telephone No. Willesden 4269.

WE are asked to announce that Mr. L. A. Horsfall, of Ing Lees, Marsden, has resigned his position as manager of E. Brook, Ltd.'s Leicester office, and has taken over the sole representation in the Midlands of the B.E.N. Patents, Ltd., 96–98, Victoria-street, S.W. 1.

MR. HENRY THOMAS TIZARD, F.R.S., has been appointed by his Majesty the King in Council to be secretary to the Committee of the Privy Council for Scientific and Industrial Research, on the retirement of Sir H. Frank Heath, K.C.B., from that office on June 1st next.

THE MINISTER OF TRANSPORT announces that he has appointed Mr. C. W. Hurcomb, Principal Assistant Secretary of the Ministry of Transport, to be Permanent Secretary of the Ministry of Transport in place of Mr. J. R. Brooke, who has been appointed by the Central Electricity Board to be its secretary.

THE CENTRAL ELECTRICITY BOARD, constituted under the Electricity (Supply) Act, 1926, announces that it has appointed Mr. J. R. Brooke, late Permanent Secretary of the Ministry of Transport, to be its secretary, and Mr. D. W. Coates, of the firm of D. W. Coates, West, Grimwood and Co., chartered accountants, to be its accountant. The offices of the Board will be at Trafalgar Buildings, 1, Charing Cross, S.W. 1.

"TRADE ALLOYS."—The Institute of Metals receives such numerous inquiries for the names of the manufacturers of the thousands of "trade alloys" that exist, that it has been decided to compile a list of "trade alloys," together with particulars of their composition and uses, as well as the names of manufacturers or agents in Great Britain. Persons interested are invited to forward to the secretary, 14, Members' Mansions, London, S.W. 1, the following particulars:—(1) Name of alloy; (2) manufacturer or agent supplying; (3) composition; (4) in what form supplied; (5) uses.

MERCHANDISE MARKS ACT, 1926.—The Board of Trade has received applications for Orders in Council to be made requiring indications of origin in the case of imported:—"Steel plates, rails, joists, angles, channels, sectional material of all descriptions, castings, forgings, rounds squares, flats, hexagons, hoops, hot and cold rolled strip, wrought iron bars, hoops, sections, plates and sheets; silk and cotton woven labels used by clothing manufacturers, merchants and retailers; gold and silver leaf." The Standing Committee appointed by the Board of Trade will hold an inquiry at 2 p.m. on Monday, April 25th, and on the mornings and afternoons of April 26th and 27th. Representatives of any interests substantially affected, who desire to be heard in opposition, should communicate with the Secretary of the Committee, Mr. E. W. Reardon, as soon as possible before April 9th, at the New Public Offices, Great George-street, Westminster, where the Committee will hold its meetings.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
Native	18/6 to 21/–
(1) Spanish	18/6 to 21/–
(1) N. African	18/6 to 21/–
N.E. Coast—	
Native	18/– to 21/–
Foreign (c.i.f.)	22/–

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	4 5 0 to 4 7 6	
No. 1 Foundry	4 11 6	—
No. 3 Foundry	4 6 6	—
N.E. Coast—		
Hematite Mixed Nos.	4 5 0	4 5 0
No. 1	4 5 0	4 5 6
Cleveland—		
No. 1	4 2 6	4 2 6
Silicious Iron	4 2 6	4 2 6
No. 3 G.M.B.	4 0 0	4 0 0
No. 4 Foundry	3 19 0	3 19 0
No. 4 Forge	3 18 6	3 18 6
Mottled	3 17 6	3 17 6
White	3 17 6	3 17 6
Midlands—		
(3) Staffs.—		
All-mine (Cold Blast)	—	—
North Staffs. Forge	4 0 0	—
,, ,, Foundry	4 7 6	—
(3) Northampton—		
Foundry No. 3	4 0 0	–
Foundry Forge	3 13 0	—
(3) Derbyshire—		
No. 3 Foundry	4 2 6	–
Forge	3 18 0	—
(3) Lincolnshire—		
No. 3 Foundry	4 1 6	–
No. 4 Forge	—	—
Basic	4 0 0	—
(4) N.W. Coast—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 17 6 (a); 5 0 6 (b); 5 4 0 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	11 5 0	—
Best	—	—
N.E. Coast—		
Iron Rivets	12 15 0	—
Common Bars	11 15 0	—
Best Bars	12 5 0	—
Lancs.—		
Crown Bars	11 0 0	—
Second Quality Bars	10 0 0	—
Hoops	14 0 0	—
S. Yorks.—		
Crown Bars	11 15 0	—
Best Bars	12 5 0	—
Hoops	14 0 0	—
Midlands—		
Crown Bars	11 10 0	—
Marked Bars (Staffs.)	14 10 0	—
Nut and Bolt Bars	10 10 0	—
Gas Tube Strip	12 15 0	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates	11 0 0	11 0 0
Ship Plates, ¼in. and up	8 7 6	£8 0 0 to 8 5 0
Sections	7 17 6	£7 10 0 to 7 15 0
Steel Sheets, under 3/16 in. to ¼in.	10 0 0 to 12 0 0	
Sheets (Gal. Cor. 24 B.G.)	—	£15 0 0 to 16 0 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	8 7 6	—
Angles	7 17 6	—
Boiler Plates	12 10 0	—
Joists	7 17 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	8 12 6	—
Soft Billets	7 12 6	—
N.W. Coast—		
Barrow—		
Heavy Rails	8 10 0†	—
Light Rails	8 15 0 to 9 0 0	
Billets	8 0 0 to 11 10 0†	
Manchester—		
Bars (Round)	9 0 0	—
,, (Small Round)	8 15 0	—
Hoops (Baling)	11 0 0	11 0 0
,, (Soft Steel)	10 15 0	10 15 0
Plates	8 15 0	—
,, (Lancs. Boiler)	11 10 0	—
Sheffield—		
Siemens Acid Billets	11 0 0	—
Hard Basic	9 2 6	—
Intermediate Basic	8 12 6	—
Soft Basic	7 15 0	—
Hoops	12 0 0	—
Soft Wire Rods	9 5 0	—
Midlands—		
Small Rolled Bars	8 15 0 to 9 0 0	
Billets and Sheet Bars	7 0 0 to 7 5 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	15 5 0	—
Angles	7 17 6 to 8 0 0	
Joists	7 17 6 to 8 0 0	
Tees	9 0 0	—
Bridge and Tank Plates	8 17 6 to 9 2 6	
Boiler Plates	11 10 0	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	19/7½ to 20/–
Block Tin (cash)	307 0 0
,, (three months)	296 15 0
Copper (cash)	55 0 0
,, (three months)	55 12 6
Spanish Lead (cash)	26 17 6
,, (three months)	27 7 6
Spelter (cash)	29 16 3
,, (three months)	30 1 3
Manchester—	
Copper, Best Selected Ingots	61 15 0
,, Electrolytic	62 10 0
,, Strong Sheets	86 0 0
,, Tubes (Basis Price) lb.	0 1 0½
Brass Tubes (Basis Price) lb.	0 0 11½
,, Condenser lb.	0 1 1½
Lead, English	28 7 6
,, Foreign	27 7 6
Spelter	30 5 0
Aluminium (per ton)	£107

FERRO ALLOYS.

(*All prices now nominal.*)

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/10½ per lb.	
Ferro Tungsten	1/6 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 0 0	7/6
,, ,, 6 p.c. to 8 p.c. ,,	£22 10 0	7/3
,, ,, 8 p.c. to 10 p.c. ,,	£22 7 6	6/6
,, ,, Specially Refined		
,, ,,Max. 2 p.c. carbon	£36 2 6	11/6
,, ,, ,, 1 p.c. ,,	£42 5 0	15/–
,, ,, ,, 0.70 p.c. carbon	£54 0 0	17/6
,, ,, ,, carbon free	1/5d. per lb.	
Metallic Chromium	3/3 per lb.	
Ferro Manganese (per ton)	£16 for home, £16 for export	
,, Silicon, 45 p.c. to 50 p.c.	£11 12 6 scale 5/– per unit	
,, ,, 75 p.c.	£18 10 0 scale 6/– per unit	
,, Vanadium	14/9 per lb.	
,, Molybdenum	5/3 per lb.	
,, Titanium (carbon free)	0/11½ per lb.	
Nickel (per ton)	£170	
Cobalt	9/3 per lb.	

FUELS.

SCOTLAND.

(*Prices not stable.*)

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	14/6
,, ,, Ell	15/3
,, ,, Splint	15/9 to 17/3
,, ,, Trebles	14/6
,, ,, Doubles	13/9
,, ,, Singles	13/3
Ayrshire—	
(f.o.b. Ports)—Steam	15/–
,, ,, Jewel	17/3
,, ,, Trebles	15/6
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	12/9 to 13/–
Screened Navigation	22/–
Trebles	13/9
Doubles	13/9
Singles	13/3
Lothians—	
(f.o.b. Leith)—Best Steam	13/3
Secondary Steam	13/–
Trebles	14/–
Doubles	13/6
Singles	13/3

ENGLAND.

	Inland.
(8) N.W. Coast—	
Steams	27/6
Household	42/6 to 58/6
Coke	32/–
Northumberland—	
Best Steams	16/–
Second Steams	15/– to 15/6
Steam Smalls	10/6
Unscreened	15/6
Household	23/– to 30/–
Durham—	
Best Gas	17/– to 17/6
Second	15/6 to 16/–
Household	23/– to 30/–
Foundry Coke	26/6 to 27/6
Sheffield—	
Best Hand-picked Branch	38/–
Best Selected House Coal	30/– to 32/–
Barnsley Best Silkstone	30/– to 32/–
Derbyshire Best Brights	30/– to 32/–
,, ,, House	28/– to 30/–
,, ,, Large Nuts	26/– to 28/–
,, ,, Small	18/– to 21/–
Yorkshire Hards	19/– to 21/–
Derbyshire Hards	19/– to 21/–
Rough Slacks	11/– to 12/–
Nutty Slacks	8/– to 9/–
Smalls	3/– to 5/6
Blast-furnace Coke (Inland)	22/– to 27/6 at ovens.*
,, ,, (Export)	f.o.b. 28/– to 30/–

(9) SOUTH WALES.

Cardiff—	
Steam Coals :	
Best Smokeless Large	23/– to 24/–
Second ,, ,,	22/6 to 23/–
Best Dry Large	21/– to 22/–
Ordinary Dry Large	20/– to 21/–
Best Black Vein Large	21/6 to 22/6
Western Valley Large	21/6 to 21/9
Best Eastern Valley Large	20/6 to 21/–
Ordinary ,, ,,	20/– to 20/6
Best Steam Smalls	14/6 to 15/6
Ordinary Smalls	13/– to 14/–
Washed Nuts	18/– to 21/6
No. 3 Rhondda Large	26/– to 26/6
,, ,, Smalls	17/– to 17/6
No. 2 ,, Large	21/– to 22/–
,, ,, Through	18/– to 19/–
,, ,, Smalls	13/– to 14/–
Foundry Coke (export)	40/– to 47/6
Furnace Coke (export)	30/– to 32/6
Patent Fuel	26/– to 27/–
Pitwood (ex ship)	42/6 to 43/6
Swansea—	
Anthracite Coals :	
Best Big Vein Large	37/6 to 40/–
Seconds	32/6 to 35/–
Red Vein	28/– to 30/–
Machine-made Cobbles	42/6 to 47/6
Nuts	45/– to 50/–
Beans	42/6 to 45/–
Peas	22/– to 24/–
Breaker Duff	8/6 to 9/3
Rubbly Culm	12/– to 12/6
Steam Coals :	
Large	22/– to 22/6
Seconds	20/6 to 21/6
Smalls	13/– to 14/–
Cargo Through	17/– to 18/–

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayreshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/– extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. † Latest quotations available.

(a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham. * Open market price. Special price for pig iron producers, 22/– per ton at ovens.

French Engineering Notes.

(From our Correspondent in Paris.)

Trade Stagnation.

THE recent slight spurt in the iron and steel trades was of short duration, and has been followed by a further lack of buying, which appears to have accentuated the general depression. Apart from the orders given out by the railway companies there is scarcely any new work available, and makers who have been completing old contracts now find themselves with very little to do. The unemployment returns would appear to indicate an improvement in the situation, but that is due largely to the number of foreign hands leaving the country, and while employers are keeping men on in the hope of an early improvement, short time has become general. It is felt that unless things take a turn for the better very shortly, the situation will become serious. Steel prices have become weaker again, partly as the result of the decision of the Steel Cartel to postpone negotiations for the constitution of a sales organisation until May next.

Continuous Brakes.

On account of the necessity of providing employment, particular stress is laid upon the importance of putting in hand, without delay, the programme for fitting continuous brakes to goods trains. The cost of doing that is so considerable that the Government can do nothing at the moment, and all sorts of suggestions are being made to overcome the difficulty. Two or three years ago a financial group was formed with the idea of advancing the necessary funds, but its offer was rejected. The Government wanted to obtain Kunze-Knorr brakes from Germany on account of reparations, but it had to abandon the idea in view of the strong opposition of home manufacturers. For some time past negotiations have been proceeding between the makers of the Kunze-Knorr brake and the Westinghouse Brake Company, with the object of settling upon some method of co-operation. Recently it was reported that the negotiations had fallen through, but they have since been resumed, and it is now stated that the Westinghouse Company and the German makers have come to an agreement which is being submitted to the respective Governments, and if the proposals receive acceptance, they will be presented to the railway companies. The nature of the proposals is not yet known. It is nevertheless suggested that an arrangement may be come to between the Government and the railway companies whereby these latter will be given facilities for paying the cost of fitting the brakes by means of a number of annuities. The fitting of continuous brakes to goods trains is regarded as urgent because it will allow of traffic being accelerated, and will add to the security of military transport.

The Kembs Barrage.

Parliament has sanctioned the putting in hand of the Kembs Barrage, which is the first of the eight dams and hydro-electrical power generating stations to be constructed on the proposed Alsace Canal running parallel with the Rhine between Kembs and Strasburg. The negotiations have been long and tedious. Germany and Switzerland were in favour of canalising the Rhine over this section, where the bed constitutes innumerable small rapids at low water and renders navigation difficult, while France, empowered by the Treaty of Versailles to construct the lateral canal, insisted on that being done as a means primarily of providing Alsace and the eastern departments with electrical energy. A dam will be constructed across the Rhine to maintain the water level in the canal, and Switzerland will have to be indemnified for the reconstruction of the drainage system of Basle, which would otherwise risk being flooded by the high level. The Kembs installation, forming the first section of the Alsace Canal, will be constructed by the Société des Forces Motrices du Haut-Rhin.

Naval Construction.

Two vessels will shortly be put on the stocks, one a mine-layer and the other an aircraft carrier. The minelayer, to be named the Pluton, will be constructed at the Lorient Arsenal. With a displacement of 5300 tons, it will have a length of 144 m., a breadth of 15·55 m., and will draw 5·20 m. of water. The engines will develop 57,000 horse-power, and the vessel will steam at a speed of 30 knots. The armament will consist of four 138 mm. guns placed axially, ten aircraft guns of 37 mm. and a number of machine guns. The aircraft carrier, to be known as the Commandant-Teste, will be contructed in a private shipyard. It will have a displacement of 10,000 tons, a length of 156 m., and a breadth of 21 m. With engines developing 20,000 horse-power its speed will be 20 knots. The armament will consist of 138 mm. and 75 mm. guns, as well as anti-aircraft guns. Unlike the Béarn, in which the aeroplanes take off from the deck, the machines in the Commandant-Teste will be discharged by catapult.

The Cameroon Railways.

When the French received a mandate for a part of the Cameroons, they found a partly constructed railway which had reached the base of a high plateau where further progress appeared to offer considerable difficulties. In 1920 they had completed the preliminary arrangements for continuing the railway from the port of Douala to the town of Youande. In order to reach the plateau the line had to pass through very difficult country, with a difference in altitude of 388 m. Over a distance of 25 miles it was necessary to build five viaducts, drive three tunnels and construct a number of small bridges. This was completed in 1925, and once on the plateau the railway was pushed forward rapidly to Youande. The work was particularly arduous on account of the necessity of recruiting labour over a very wide and sparsely populated region. A branch line has also been completed to the navigable limit of the river Nyong. At the same time, the Port of Douala has been improved and enlarged, and about 600 miles of road have been constructed, so that the French Cameroons are now, it is said, on the point of undergoing a considerable commercial development.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

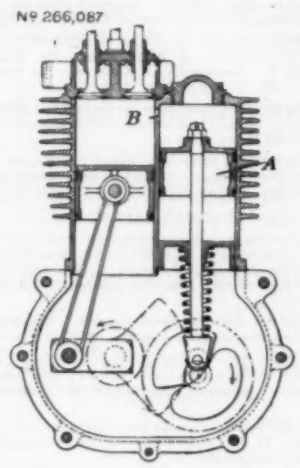
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

266,087. December 16th, 1925.—SUPERCHARGERS, H. R. H. Trevor-Battye, Little Hampden Manor, Great Missenden, Bucks.

In this engine the supercharger piston A is worked by means of a cam driven off the crank shaft by timing gears in such a manner that the main and supercharger pistons work in unison

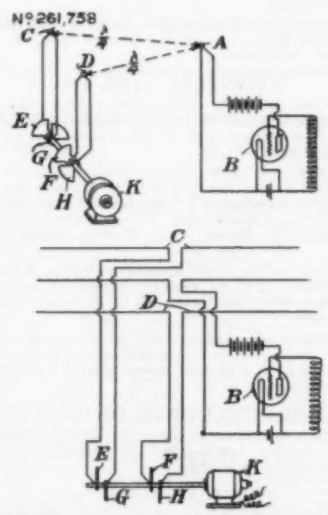


during the suction and compression; but the supercharger remains stationary, at the top of its stroke, during the working and exhaust strokes. In this position it covers the communication port B, so that the cam is not subjected to the explosion pressure.—*February 24th*, 1927.

TELEGRAPHS AND TELEPHONES.

261,758. November 17th, 1926.—IMPROVEMENTS IN OR RELATING TO WIRELESS TELEGRAPHY AND TELEPHONY, *Marconi's Wireless Telegraph Company, Ltd., of Marconi House, Strand, London, W.C. 2.*

In accordance with this invention a beam wobbler is employed to overcome the effect of fading signals in radio communication. Referring to the upper drawing, A is an antenna one-half wave length long, and of the type usually known as a "doublet antenna," having extensions in opposite directions, either vertical or horizontal, and connected to the transmitter B. C and D are reflector wires parallel to the double antenna, and one-quarter of a wave length away from it. The angular distance between the two reflector wires, which serve to determine the



amount of wobble, will depend upon the service for which it is intended to be used, and it is also dependent upon the particular situation and characteristics of the surroundings. The length of the reflectors D and C should be approximately the same as that of the antenna A. E and F are stationary plates of variable condensers connected to the reflector wires C and D, whilst G and H are movable condenser plates also connected to those reflector wires. All the movable condenser plates are mounted upon a single shaft, which is connected to the motor. The function of the condensers is to vary the tuning of the reflectors alternately, so that first one wire reflects the waves and then the other, and this wobbles the reflected waves or beams from one direction to the other.—*February 17th*, 1926.

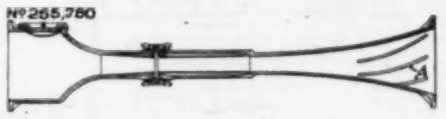
253,483. April 9th, 1926.—IMPROVEMENTS IN TELEGRAPH SUBMARINE CABLE WITH LOADING COILS, Felten and Guilleaume Carlswerk Actiengesellschaft, of Köln-Mülheim, Germany.

According to this invention a cable used for tone-frequency telegraphy is constructed in such a manner that the properties of the coils are graded only in one direction of the cable. At the part of the cable from which the highest tone frequency is transmitted coils are used in the first section which show for the highest frequency an increase in resistance due to alternating current, that is as small as possible for large currents, whilst their continuous current resistance is comparatively higher. The coils of the following second section have a continuous current resistance, which is slightly smaller, whilst the loss constants are higher, and so on for any desired number of sections up to the last section, the coils of which have the smallest continuous current resistance and the highest loss constants. As a general rule, it may be stated that the coils, assuming them to be of the same width or size, have, as regards the current of highest frequency in the section, the smallest total resistance—continuous current resistance plus increase in resistance due to alternating current. The size of the coils may, of course, be varied according to the external conditions—depth of water, &c. Although as regards the transmission in the opposite direction the distribution of the coils in this case would *per se* be unfavourable, owing to the resistance being greatly increased at the points where the currents are large, sufficiently small damping can, nevertheless, be obtained since a lower frequency is used in this direction and the losses as well as the return conductor constituted by the sea are correspondingly smaller.—*February* 17th, 1927.

MEASURING AND TESTING INSTRUMENTS.

265,780. February 17th, 1926.—VENTURI METERS, D. Brown, Canal Ironworks, Hawthorn-road, Bootle.

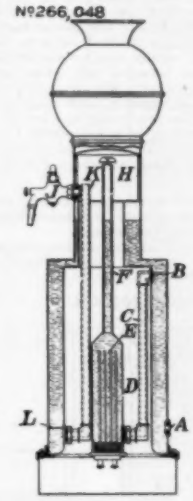
This invention is concerned with meters of the Venturi type in which the overall length is reduced to a minimum with the object of economising space. It has been found that if the cones



are made of too abrupt a curvature there is a tendency for the water to surge in the outlet and to interfere with the registration of the flow. The inventor, however, says that the introduction of spiral guide vanes A in the outlet from the meter will overcome this trouble. They may also be used in the inlet.—*February 17th*, 1927.

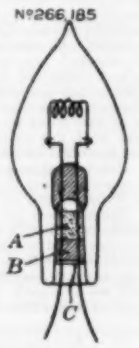
LIGHTING AND HEATING.

266,048. November 17th, 1925.—IMPROVEMENTS IN SELF-FEEDING ELECTRICALLY HEATED WATER BOILERS, Jackson Boilers, Ltd., of 124, Albion-street, Leeds, and Harold Hargreaves, of 45, Hollingreave-road, Burnley.



The main water chamber of this heater is in the form of a jacket with an inlet A for cold water and an outlet B. A pipe C connects the outlet with the lower portion of the boiling chamber D. In this boiling chamber electrical heating elements E are placed. An expansion pipe F leads from the boiling chamber to the collecting chamber H. A draw-off tap is provided at J. An overflow pipe is also provided at K and a baffle plate L prevents the water rising straight up. In the bottom of the collecting chamber H there is a hole for slowly draining any water that may be left in this chamber back to the bulk water chamber. The water in the boiling chamber D is readily boiled and it rises in the expansion pipe F and flows over into the collecting chamber H, from whence it can be drawn off by the tap J. If the supply of boiling water to the collecting chamber H exceeds the demand, the boiling water passes through the upper open end K of the overflow pipe to the bottom the bulk water chamber, of with the water in which it mixes for preheating purposes. There are two other illustrations relating to an alternative construction.—*February* 17*th*, 1927.

266,185. June 7th, 1926.—IMPROVED SAFETY DEVICE FOR SERIES-CONNECTED INCANDESCENT ELECTRIC LAMPS, Fritz Eckhardt and Max Hohnekamp, of Euckenstrasse 26/28, Eisenach, Germany.



This specification describes a by-pass for the filaments of incandescent lamps and it comes into action when the filament of a series-connected lamp burns out so that the remainder of the lamps are not extinguished. The by-pass consists of aluminium powder A enclosed by a small plug of asbestos wool and a water-tight cover C. When subjected to the normal voltage of the lamp the by-pass is non-conductive, but its resistance is reduced when it is subjected to the full voltage of the series. The specification states that the aluminium powder may be mixed with other powders or with a sticky fluid.—*February 24th* 1927.

MISCELLANEOUS.

257,236. July 21st, 1926.—IMPROVEMENTS IN OR RELATING TO THE PROTECTION OF SUPPLY SYSTEMS FROM HIGH-VOLTAGE SURGES AND THE LIKE, Sieverts Kabelverk, Max Sieverts Fabriks Aktiebolag, of Esplanaden 7, Sunbyberg, near Stockholm, Sweden.

It is well known that when a static condenser is connected into an open-wire or overhead network, the amplitude will be reduced and the wave front of high voltage surges appearing in the network will be improved. The static condenser has also been extensively used as a power factor corrector in alternating-current networks, and it is well known that the condenser adapted for power factor correction has, in certain connecting methods, a protective influence against high voltage surges. In order to

permit the condenser to protect transformers or other electric devices from surges on a line due, for example, to atmospheric disturbances, the condenser has been connected as shown diagrammatically in Fig. 1, e being the amplitude of the surge. The diagram of Fig. 2 applies to a three-phase system in case of star connection. When using the connection according to Fig. 2, the normal tension $\frac{E}{\sqrt{3}}$ volts across each condenser will, in the case of defects occurring in one of the phases in the network, rise to E volts, and at the same time the di-electric heat developed on account of the number of periods and the tension will rise to thrice the normal value. To enable the condensers to stand the strains with this connection, they should be of a size corresponding to a voltage of $\sqrt{3}$ times higher than the normal working voltage. Under normal operating conditions the compensating condenser will only deliver one-third of its full power.

No 257,236

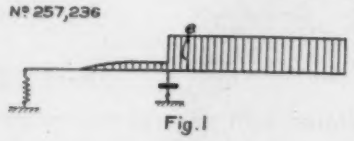


Fig. 1

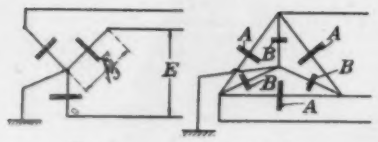


Fig. 2

Fig. 3

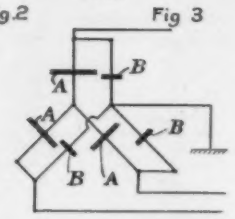


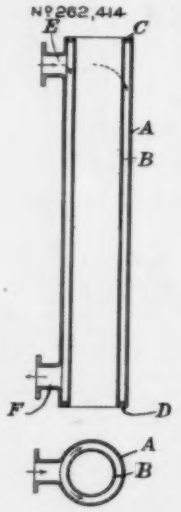
Fig. 4

and on the occurrence of a phase defect the current in the neutral wire will attain a value $\sqrt{3}$ times the normal phase current. As the condenser necessary to neutralise the amplitude of reasonable excess tensions usually has a value between 0·01 and 0·1 microfarad, only a very small part of the capacity of the power factor correcting condenser is necessary for protection from excess tension. According to this invention, the power factor correcting heavy current condensers are inserted between the phases without an earth connection, whilst smaller condensers with heavier insulation are inserted between each phase and earth for protection from excess tension. Fig. 3 shows the manner in which the condensers are arranged in mesh connected three-phase systems, where A are the power factor correcting condensers and B the condensers acting as a protection from excess tensions or surges; whilst Fig. 4 shows a corresponding scheme for a star-connected three-phase system.—*February 17th*, 1927.

262,414. November 22nd, 1926.—Oil-cooling Means for Oil-immersed Electrical Apparatus, Maschinenfabrik Oerlikon, of Oerlikon, near Zürich, Switzerland.

This invention relates to oil cooling means for electrical apparatus immersed in oil. A cooler consisting of an exposed outer tube and a substantially coaxial open-ended inner tube is provided with branches whereby it can be connected singly to the transformer or the other casing. The arrangement permits the individual tubes to be of relatively large diameter, which promotes the natural flow of the air. The two coaxial vertically disposed tubes A and B are welded together at the ends by means of interposed rings C and D. The upper and lower ends of the outer tube A are each provided with a branch E and F respectively. The oil to be cooled enters through the branch E, connected to the casing of the transformer, flows downward between the tubes A and B, and issues from the cooler through the branch F, likewise connected to the casing. Air ascends, by natural draught, outside the tube A and inside the tube B, and deprives the descending oil of its heat. To facilitate the transfer of heat from the oil to the metal wall, the oil may be caused to describe a spiral course in its descent through the annular space between the tubes A and B by means of guide plates. The narrower the space between the two tubes A and B, and the more rapid the flow of oil, the more favourable will be the transfer of heat from the oil to the walls of the tube. The two tubes A and B may also be connected together by means of stuffing-boxes or elastic walls instead of by means of rings C and D.—*February 17th*, 1927.

No 262,414



North-East Coast Institution of Engineers and Shipbuilders.—The North-East Coast Institution of Engineers and Shipbuilders is to hold a summer meeting in Glasgow jointly with the Institution of Engineers and Shipbuilders in Scotland, from Monday, June 20th, to Thursday, June 23rd next inclusive. An outline of the proposed programme is as follows:—On the evening of Monday, June 20th, there will be a reception in the Rankine Hall of the Glasgow Institution. On the Tuesday morning there will be a reception of the Presidents, Councils and members of both Institutions, followed by the reading and discussion of papers, visits to works and other places of interest being made in the afternoon. In the evening there is to be a Civic reception. On the Wednesday morning further papers will be read and discussed, the afternoon being devoted to visits to works and other places of interest, which will be followed in the evening by a banquet. On the Thursday there will be excursions to Arran, or to Crieff, returning *vid* Aberfoyle.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

Institution of Civil Engineers: Birmingham and District Association.—Chamber of Commerce, New-street, Birmingham. Lecture, "The Testing of Heat Engines," by Mr. H. R. J. Burstall. 6 p.m.

Institution of Mechanical Engineers.—Storey's-gate, Westminster, London, S.W. 1. Joint meeting with Chemical Engineering Group. Paper, "Lubricating Oils—Laboratory Tests in Relation to Practical Results," by Messrs. A. G. Marshall and C. H. Barton. 6 p.m.

Institution of Mechanical Engineers.—Storey's-gate, Westminster, London, S.W. 1. Informal meeting. Discussion on "British Empire and Overseas Trade," by Major A. W. Farrer. 7 p.m.

Junior Institution of Engineers.—39, Victoria-street, London, S.W. 1. Lecturette, "Notes on the Production of Saltpetre," by Mr. G. J. Hartley. 7.30 p.m.

Royal Institution of Great Britain.—21, Albemarle-street, London, W. 1. Discourse, "The Stones of London," by Mr. J. Allen Howe. 9 p.m.

West of Scotland Iron and Steel Institute.—Room 24, Royal Technical College, George-street, Glasgow. Annual general meeting. 7 p.m.

SATURDAY, APRIL 2ND.

Institute of British Foundrymen: Lancashire Branch.—College of Technology, Sackville-street, Manchester. Annual general meeting at 3 p.m. Lecture, "Absorbed Gases in Iron and the Creation of Gas Holes in Castings," by Mr. B. Hird. 4 p.m.

Institution of Engineers-in-Charge.—Venetian Chamber of the Holborn Restaurant, London, W.C. 1. Annual dinner. 6 for 6.30 p.m.

Institution of Municipal and County Engineers.—Town Hall, Bradford. Quarterly meeting of the Yorkshire District. 2 p.m.

Royal Institution of Great Britain.—21, Albemarle-street, London, W. 1. "The Alpha Rays and Atomic Structure," by Sir Ernest Rutherford. 3 p.m.

MONDAY, APRIL 4TH.

Institution of Automobile Engineers: Western Centre.—Merchant Venturers' Technical College, Bristol. Paper, "Automobile Repairs," by Mr. W. G. Ruggins. 6.45 p.m.

Royal Institution of Great Britain.—21, Albemarle-street, London, W. 1. General meeting. 5 p.m.

Society of Engineers.—Geological Society's Apartments, Burlington House, Piccadilly, London, W. 1. Paper, "Some Aspects of Reinforced Concrete," by Mr. G. C. Workman. 5.30 p.m.

TUESDAY, APRIL 5TH.

Institution of Automobile Engineers.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Paper, "The High-tension Magneto, with Especial Reference to its Design, Manufacture and Service," by Messrs. A. P. Young and L. Griffiths. 7.45 p.m.

Institution of Civil Engineers.—Great George-street, Westminster, London, S.W. 1. Paper, "Enlargement of the City and South London Railway Tunnels," by Messrs. I. J. Jones and G. Curry. 6 p.m.

Institution of Electrical Engineers: North Midland Centre.—Hotel Metropole, King-street, Leeds. Annual general meeting. 6.45 p.m.

Royal Institution of Great Britain.—21, Albemarle-street, London, W. 1. "Some Properties of Coke," by Professor J. W. Cobb. 5.15 p.m.

WEDNESDAY, APRIL 6TH.

Institution of Civil Engineers.—Great George-street, Westminster, London, S.W. 1. Informal meeting. Discussion on "Methods of Preserving Structures," introduced by Mr. F. E. Wentworth-Shields. 6 p.m.

Institution of Electrical Engineers.—Savoy-place, Victoria Embankment, London, W.C. 2. Wireless Section meeting. "Battery Eliminators or Appliances for the Operation of Radio Receiving Apparatus by Energy Derived from Electric Supply Mains," by Messrs. P. R. Coursey and H. Andrewes. 6 p.m.

Institution of Sanitary Engineers.—Caxton Hall, Westminster, London, S.W. 1. Paper, "Kingsbury Main Drainage Scheme, 1924–1926," by Messrs. R. C. N. Newport and E. O. Danger. 6 p.m.

North-East Coast Institution of Engineers and Shipbuilders.—Bolbec Hall, Newcastle-upon-Tyne. Graduate Section meeting. "A Modern Power Station," by Mr. W. W. Bath. 7.15 p.m.

WEDNESDAY TO FRIDAY, APRIL 6TH TO 8TH.

Institution of Naval Architects.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Annual general meeting. For programme see page 336.

THURSDAY, APRIL 7TH.

Institution of Electrical Engineers.—Savoy-place, Victoria Embankment, London, W.C. 2. "A Contribution to the Study of the Number of Tests Required to Establish the Rupturing Capacity of an Oil Circuit Breaker," by Messrs. E. B. Wedmore, W. B. Whitney, and C. E. R. Bruce. 6 p.m.

Optical Society.—Imperial College of Science, South Kensington, London, S.W. 7. Papers: "Huygen's Principle and the Phenomena of Total Reflection," by Professor C. V. Raman; and "The Hartmann Formula for the Dispersion of Optical Glass," by Mr. H. W. Lee. 7.30 p.m.

Royal Aeronautical Society.—Royal Society of Arts, 18, John-street, Adelphi, London, W.C. 2. Lecture, "Parachutes," by Flight-Lieutenant F. O. Soden. 5.15 p.m.

FRIDAY, APRIL 8TH.

Institution of Mechanical Engineers.—Storey's Gate, Westminster, London, S.W. 1. Paper, "Internal-combustion Locomotives," by Lieut.-Colonel E. Kitson Clark. 6 p.m.

Institute of Metals: Sheffield Local Section.—Applied Science Department of the University, St. George's-square, Sheffield. "Refined Silver for Electro-plating Anodes," by Mr. E. A. Smith. 7.30 p.m.

Joint Delegation of the Yorkshire Associations of the Institutions of Civil, Mechanical, Electrical, Municipal and County, and Locomotive Engineers.—Great Northern Hotel, Leeds. Second annual dinner. 6.30 for 7 p.m.

Junior Institution of Engineers.—39, Victoria-street, London, S.W. 1. Paper, "Electrical Osmosis," by Mr. E. Ambrose. 7.30 p.m.

Royal Institution of Great Britain.—21, Albemarle-street, London, W. 1. Discourse, "Early Days in Radio Activity," by Sir Ernest Rutherford. 9 p.m.

West Bromwich Engineering Society.—Technical College, West Bromwich. Paper, "Electricity the Power of To-morrow," by Mr. G. S. Francis. 7.30 p.m.

SATURDAY, APRIL 9TH.

Junior Institution of Engineers.—Visit to the workshops and laboratory of S. G. Brown, Ltd., at Acton. 2.30 p.m.

Royal Institution of Great Britain.—21, Albemarle-street, London, W. 1. "The Alpha Rays and Atomic Structure," by Sir Ernest Rutherford. 3 p.m.

MONDAY, APRIL 11TH.

Railway Club.—25, Tothill-street, London, S.W. 1. Paper, "The Importance of Secondary Train Services," by Mr. J. F. Gairns. 7.30 p.m.

TUESDAY, APRIL 12TH.

Crystal Palace School of Practical Engineering.—London, S.E. 163rd Award of Certificates, by Mr. E. F. C. Trench. 3 p.m.

Institute of British Foundrymen: Lancashire Branch, Burnley Section.—Municipal College, Burnley. Annual general meeting. 7.15 p.m.

Institution of Engineers and Shipbuilders in Scotland.—39, Elmbank-crescent, Glasgow. Paper, "Latest Developments in Underfeed Stoker Practice in the United States," by Mr. J. G. Worker. 7.30 p.m.

Belfast Association of Engineers.—At a meeting of the Belfast Association of Engineers, which was held on Wednesday evening, March 23rd, Mr. J. Burdon, A.M. Inst. C.E., of London, read a paper on "The Latest Two-cycle Double-acting Oil Engine." The author described the special features of the Worthington two-cycle double-acting marine oil engine and referred to the performance of the engines of the two-cycle type which have been installed on the motor vessels Tampa and Umcoi. These are each four-cylinder single-screw units with cylinders of 28in. diameter and a stroke of 40in. They are each designed for a rated output of 2900 S.H.P. at a normal speed of 95 R.P.M. For the present, Mr. Burdon concludes, the largest size of Worthington engine contemplated would have 34in. diameter cylinders with a stroke of 48in., and would be designed to develop an output of 1500 B.H.P. per cylinder at a speed of 110 R.P.M., so that by employing eight-cylinder units a total of 12,000 S.H.P. could be transmitted to each propeller.

The Institution of Civil Engineers.—The annual dinner of the Institution of Civil Engineers was held in the Great Hall of the Institution Building on Friday, March 25th, and was at least as well attended as former dinners, the hall being quite full. The President, Mr. Frederick Palmer, occupied the chair, and the principal guests were Lord Ritchie of Dundee, Chairman of the Port of London Authority; Mr. J. M. Gatti, Chairman of the London County Council; and the Right Hon. J. H. Thomas, P.C. The toast of "The Institution" was proposed by Mr. Gatti. The President acknowledged the toast in the happy vein to which he has accustomed us. Sir Robert Elliott-Cooper proposed the toast of "Our Guests," with no little care, and to it Lord Ritchie and Mr. Thomas responded. In his speech, Lord Ritchie referred in the warmest terms to Mr. Palmer's long connection with the Port of London Authority, and expressed its pleasure that, after leaving it for some years, he was once more acting as its consulting engineer. Mr. Thomas's response was a typical labour leader's after-dinner speech.

A Large Refrigerator Motor Ship.—It is announced that the Fairfield Shipbuilding and Engineering Company, Ltd., of Govan, has received from the British and Argentine Steam Navigation Company, Ltd., of London, an order for a twin-screw motor vessel, which will be similar as regards dimensions and propelling machinery to the Upwey Grange, which was constructed by the same builders for the Houlder Line, Ltd., and was described in our issue of December 18th, 1925. At the present time, the Fairfield Company has on its stocks a sister ship to the Upwey Grange, which is also built being for the Houlder Line, Ltd. The new vessel, although it will be owned by the British and Argentine Steam Navigation Company, Ltd., will belong to the Furness Lines group, as does the Houlder Line. The principal dimensions of the new vessel will be approximately as follows:—Length overall, 431ft.; breadth moulded, 62ft. 3in.; depth moulded, 38ft. 3in.; and gross tonnage, 9130. The engines will consist of two six-cylinder sets of Fairfield-Sulzer motors, designed for a total output of 6400 B.H.P., and to give a service speed of about 14½ knots.

Engineering Golfing Society.—The Spring Meeting of the Engineering Golfing Society will be held at Littlestone, Kent, on Saturday and Sunday, May 7th and 8th, by the courtesy of the Littlestone Golf Club. The following programme has been arranged:—On the Saturday morning the "Timmis Challenge Cups" will be completed for by four-ball foursome match play against bogey in an eighteen-hole round. Mementoes and second prizes will be given. In the afternoon there will be an eighteen-hole round, two-ball foursome match play against bogey. Two first and two second prizes will be given. On the Sunday morning the "President's Challenge Cup" will be competed for by members in the First Division, with handicaps of 10 and under, and the "Wilson Challenge Cup" by members in the Second Division, with handicaps of 11 and over. A memento and a second prize will be given in each division. There will also be prizes for the best scratch scores in each division, presented by the Captain. In the afternoon there will be team matches—North *v.* South and E.G.S. *v.* Littlestone Golf Club. Other matches will be arranged after the entries have been received. Entries close first post on Friday, April 22nd.

Conference of Public Lighting Engineers.—A conference of public lighting engineers is to be held at Brighton in September next under the auspices of the Institution of Public Lighting Engineers. It will start on Monday, September 12th, and terminate on Thursday, the 15th, and it will be under the chairmanship of the incoming President of the Institution, Mr. Alex. C. Cramb, electrical engineer and manager of Croydon. The following papers have been arranged for:—(1) "The Public Lighting Scheme of the Borough of Brighton," by Mr. John Christie, M.I.E.E., Engineer and Manager of the Electricity Department of the Corporation of Brighton; (2) "Road Traffic and Street Lighting, as seen by a Chief Constable," by Mr. R. L. Matthews, Chief Constable of the City of Leeds; and (3) "Descriptive of the British Engineering Standards Association. Standard Specification for Street Lighting," by Captain L. B. W. Jolley, M.I.E.E., Research Engineer, General Electric Company's Research Laboratories, Wembley, and Mr. Robert Watson, M. Inst. G.E., Engineer and Manager of the Corporation Gas Department of the City of Doncaster. During the continuance of the conference there will be an exhibition of some of the most modern street lighting appliances.